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UNIVERSITY OF ALBERTA

International Trade in Wheat Flour: A Canadian Perspective

by

Gwendolyn Grace Mansell

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF

Master of Science

IN

Agricultural Economics

Department of Rural Economy

EDMONTON, ALBERTA

Spring, 1990

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"In China rice is life. In Canada life is wheat. We should throw wheat on our brides."

Emily Gowan Murphy
(1910)

UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled International Trade in Wheat Flour: A Canadian Perspective submitted by Gwendolyn Grace Mansell in partial fulfilment of the requirements for the degree of Master Science in Agricultural Economics.

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S.E. Drugge

Date: 23 April 1990

Abstract

In this study an investigation into the changes in the world wheat flour market was done through a combination of qualitative analysis, the use of a simple linear transportation model, and a constant market share approach. The resulting analysis suggests that changes in production capability, changes in technology, changes in domestic policies and the development of international organizations and structures have all had differing levels of impact on the wheat flour trade.

The simple linear transportation model simulates a world which is free of product and sourcing preferences and in which trade restrictions do not apply. By placing further bounds on the model it can be shown that existing patterns of trade are more closely aligned with a restricted model. In this formulation Canada is restricted from shipping to the Middle East and North African markets, due presumably to product preferences for white kernel wheats, and the United States is restricted from shipping to the Soviet Union, China and Cuba. In the first two instances, this is thought to be due to sourcing preferences and in the latter case it is due to a United States ban on trade with Cuba.

The constant market share model shows that, despite an increase in the size of the total flour market, a decline in Canadian competitiveness and distribution effects have conspired to reduce overall Canadian market share. During the same time, American market share increased significantly due largely to size of market and competitive effects. European Community market share remained relatively stable, but size of market and distributional effects were necessary to offset the loss of competitiveness. Australia was virtually eliminated as a major participant in the wheat flour market due to distributional and competitive effects.

As a result of the analysis, the conclusion is reached that extra market factors have been more important than market factors in influencing trade patterns. However, a return to market conditions will not necessarily increase world trade in wheat flour relative to wheat and other wheat products such as gluten.

Acknowledgement

I would like to thank the staff and students in the Department of Rural Economy for making my stay in the Department, both interesting and enjoyable. Particular thanks are due to my supervisor, Dr. Michelle Veeman, for her guidance and support and the other members of my Committee, Dr. Travis Manning, Professor Wayne Anderson and Dr. Sten Drugge, for their helpful comments. Cas Freeman also deserves acknowledgement and thanks for her advice, support and encouragement.

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I. Introduction

The purpose of this thesis is to explain some of the changing patterns in international trade in wheat flour. According to the pure theory of international trade, comparative advantage determines trading patterns. The natural endowment of land, labour and capital in each region determines the lowest cost of production and confers an absolute advantage on a particular region for the production of a particular product. The relative costs of production between trading regions determine comparative advantage. However, several additional factors must be looked at to explain the actual patterns of trade. These include differences in tastes and preferences between different populations, government subsidies which may convey a competitive advantage, transport costs, market power and other market imperfections. From this study, it is concluded that these "other" factors play an important role in explaining much of the trade in wheat flour.

Wheat has been traded since biblical times when King Solomon exported wheat to Lebanon to acquire timbers to construct his temple (Storey, 1986, p. 572) and Canada has been a significant exporter of wheat and wheat flour since the early 1800s, (Easterbrock and Aitken, 1975, p. 157). However, in this thesis the focus is on the wheat flour trade in the latter half of the 20th century, particularly since 1960.

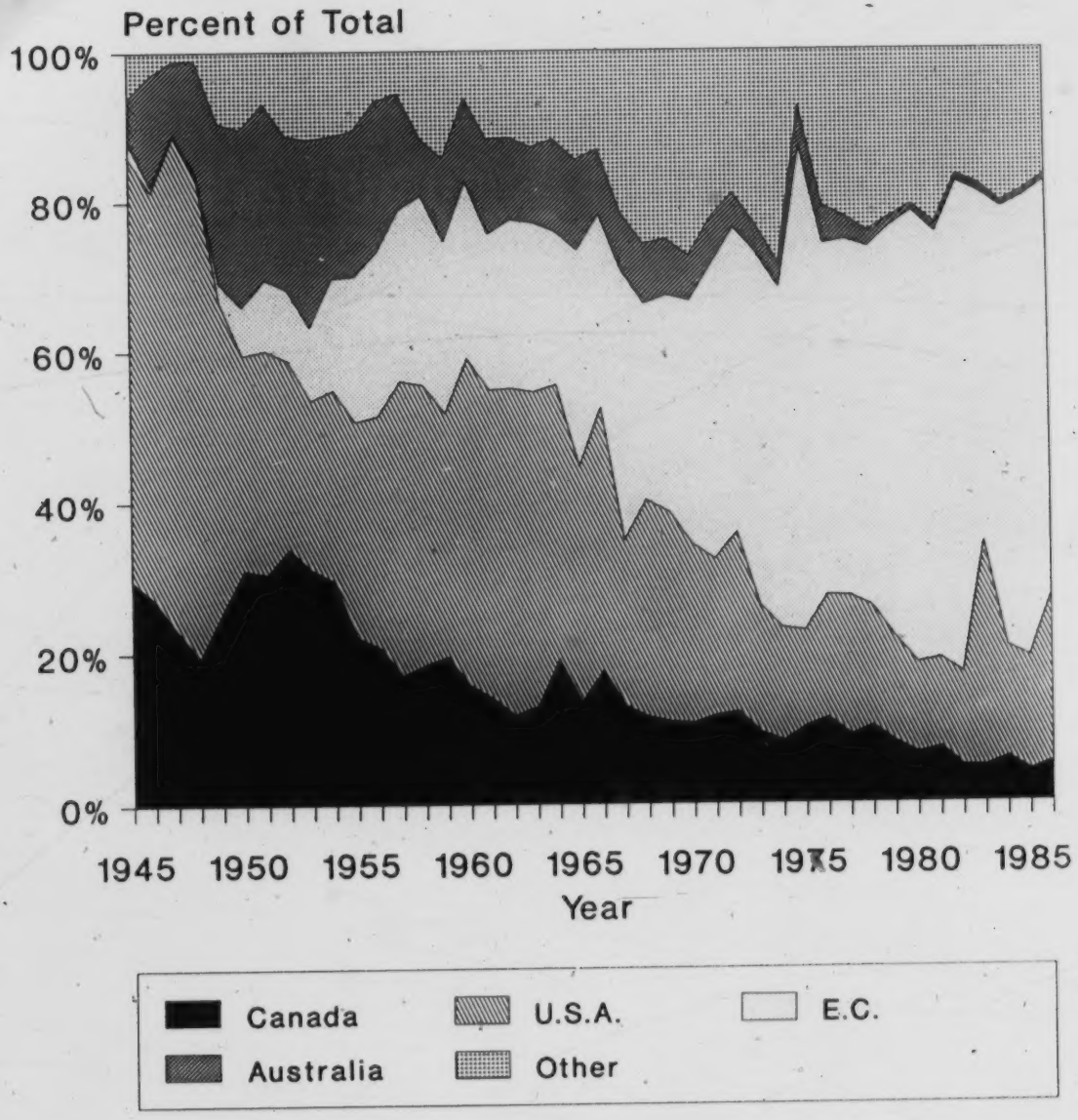
The best period for North American exports of flour occurred after World War II when the European agricultural industry was yet to be rebuilt, but by 1950 European agriculture had begun to recover. North American flour exports declined from almost 90 per cent of total world exports in 1945, to 59 per cent by 1960, and by 1986 they represented only 27 per cent of world flour exports.[1] The market share figures for Canada over the same time period were 30 per cent, 16 per cent, and five per cent, respectively. The relative changes in market share for selected exporters between 1945 and 1986 are shown in Graph 1.[2] Europe as

[1]Note that in 1983 and 1986 United States market share rebounded, but more normal levels throughout the 1980s were around 12 per cent, making North American market share about 17 per cent.

[2]Data for Graphs 1 through 5 are from various issues of the *F.A.O. Trade Yearbook*. Changes in reporting trade statistics throughout the years makes earlier data difficult to compare to the more recent time period and thus the graphs should be interpreted as showing trends rather than absolute quantitative changes.

GRAPH 1

MARKET SHARE OF FLOUR EXPORTERS 1945 - 1986



Source: *F.A.O. Trade Yearbook*, various years.

a whole entered as a major exporter in about 1958 when their market share climbed above 25 per cent and by about 1973 the region was responsible for about 50 per cent of world exports, although much of this would have been intra-region trade. France, West Germany, Italy and more recently Greece have been dominant European exporters of flour in the post war period, while until about 1966 the United Kingdom was responsible for roughly between five and 17 per cent of world imports (Graph 2). In the immediate pre-war period, Europe was a net importing region and Greece never even began to export until the latter half of the 1960s.

Africa (particularly North Africa) and the Union of Soviet Socialist Republics (Soviet Union or U.S.S.R.) emerged as major flour importing regions in the post-war era. Imports into Asia remained relatively stable (at approximately 25 to 30 per cent of world imports) but the importing countries changed significantly. India, Sri Lanka, and the Philippines declined in importance as importing nations, while the Arab nations, particularly Iraq and Iran, and China became major importers (Graph 3).

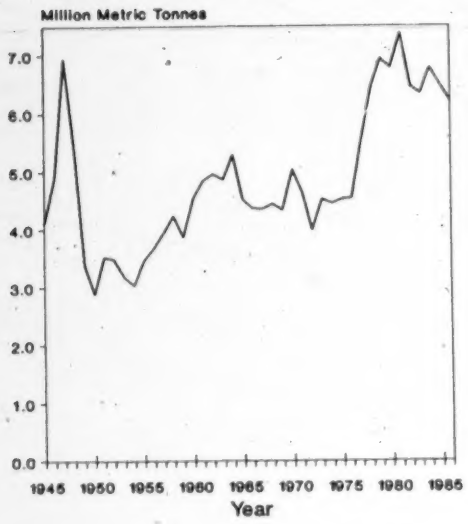
Canadian exports of wheat flour have actually declined only slightly during the post war period (Graph 4). However, flour exports have represented a decreasing share of Canadian wheat and wheat flour exports (Graph 5).[3] Canadian exports to particular regions have been erratic. Western Europe, particularly the United Kingdom, and South America have declined in importance as purchasers of Canadian flour while the Middle East, Africa, Asia and Cuba have become the major importing regions. By the 1977-78 crop year, Iceland had become the largest European importer of Canadian wheat flour.

Why have these changing patterns of wheat flour trade occurred? An attempt is made in this thesis to explain the shifts in trade by describing some of the changes in international organizations and structures; the increased intervention by governments both in domestic and international markets; different consumption patterns in newer markets; and changes in production, processing, handling and transportation technology; all of which have had

[3]Note that a 72 per cent extraction rate was generally used. However, in earlier data for wheat and wheat flour, the Food and Agriculture Organization made an exception for United States and Canadian exports and these were calculated at extraction rates of 71.5 and 72.6 per cent respectively.

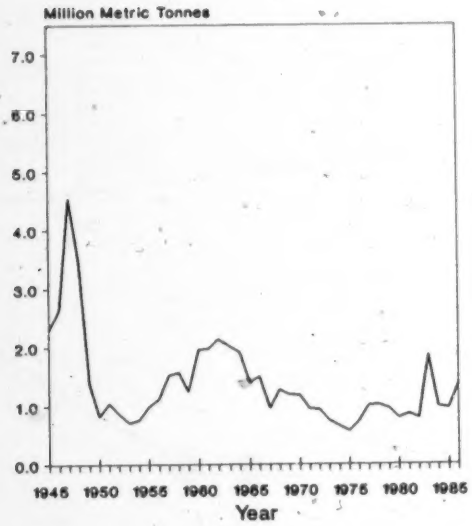
GRAPH 2
EXPORTS FROM SELECT REGIONS
1945 - 1986

WORLD

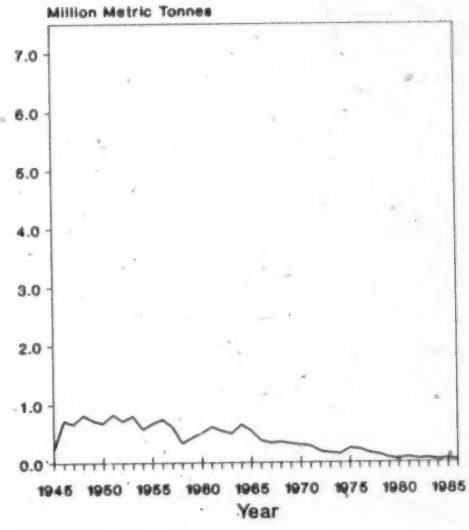


EUROPE

U.S.A.



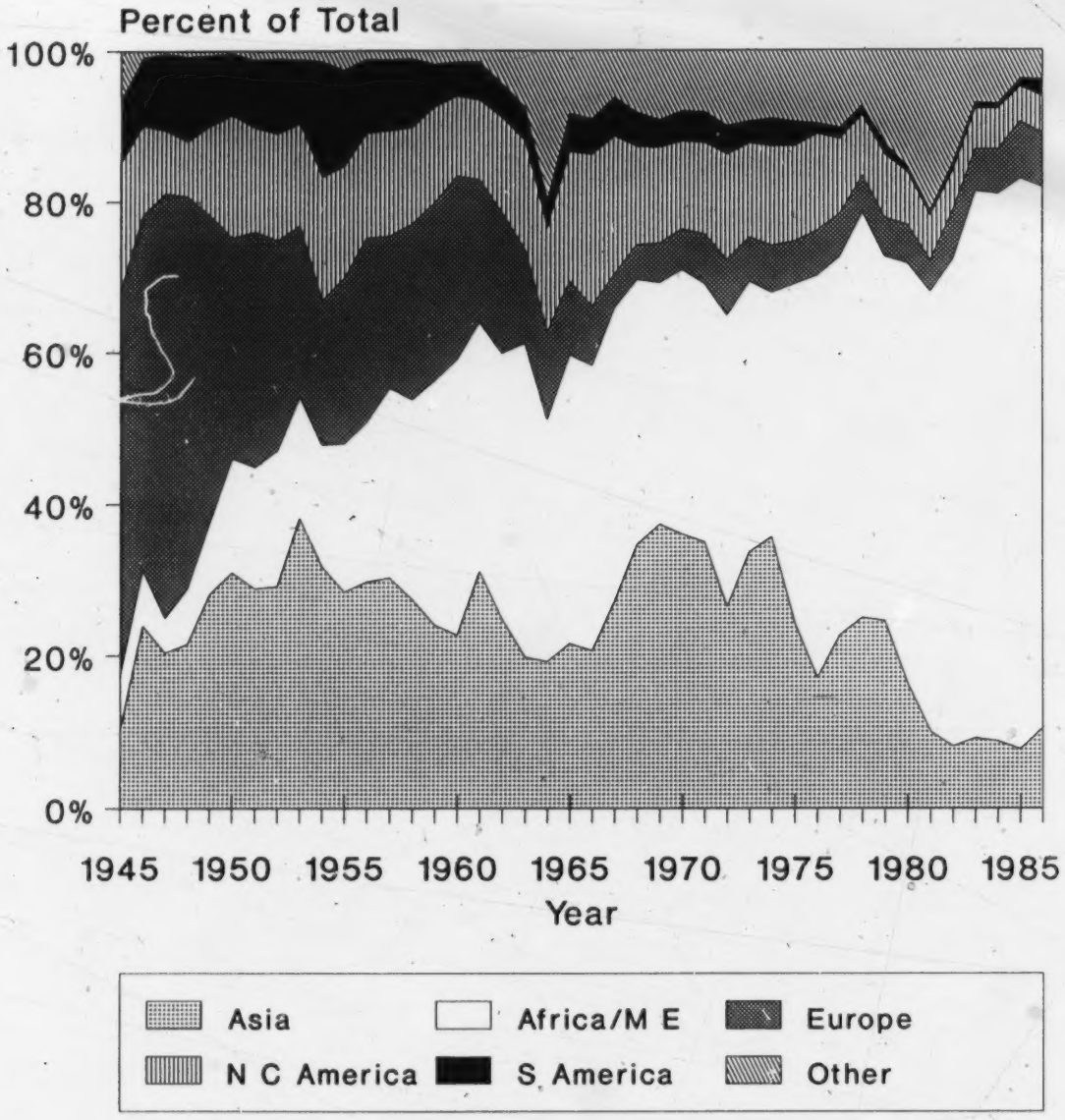
AUSTRALIA



Source: *F.A.O. Trade Yearbook*, various years.

GRAPH 3

SHARE OF IMPORTS BY REGION 1945 - 1986



Source: *F.A.O. Trade Yearbook*, various years.

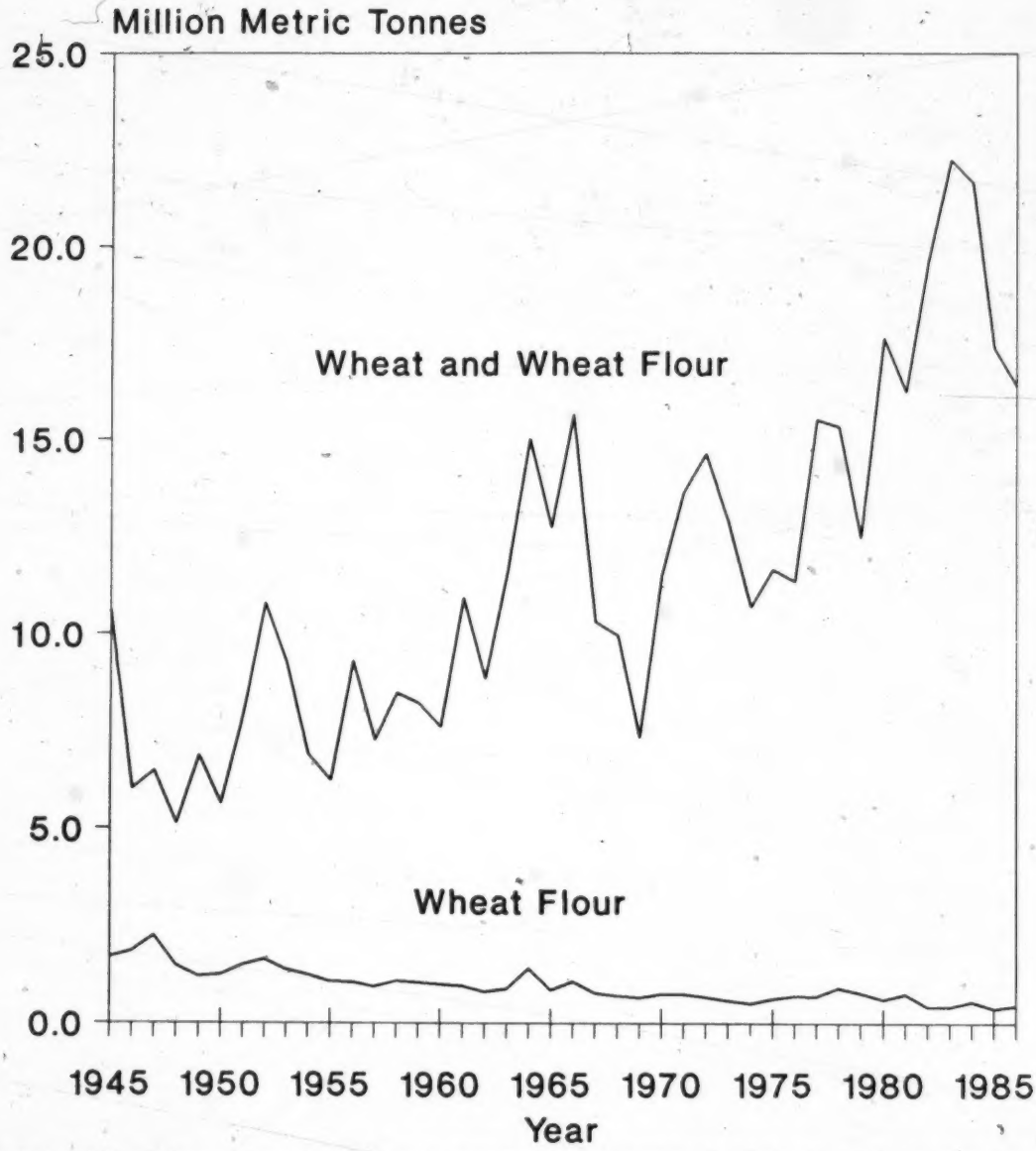
GRAPH 4

CANADIAN *vs* WORLD EXPORTS OF FLOUR 1945 - 1986

Source: *F.A.O. Trade Yearbook*, various years.

GRAPH 5

FLOUR *vs* WHEAT AND FLOUR EXPORTS
Canada 1945 - 1986



Note: All values are in wheat equivalent calculated at 72% extraction.
Source: *F.A.O. Trade Yearbook*, various years.

different impacts on international markets. In a subsequent section, a simple linear transportation model was developed, to explore the relationship between the patterns of trade and transportation costs. In a final analytical chapter the shifts in the patterns of trade were investigated using a constant market share analysis.

II. The International Market

A. Historical Overview

The 20th century marked four major changes which significantly and irrevocably changed world wheat and wheat flour market structure. They can be broadly classified as changes in production capability, changes in technology, changes in domestic policies, and the development of international organizations and structures. All of these factors acted in consort to shift the patterns of trade.

World War II significantly affected agriculture in the western hemisphere. World grain production did not reach pre-war levels until 1952-53. European countries, devastated by the war, began to look for a method of increasing European food self-sufficiency. Shortly after the formation of the European Community (E.C.) in 1957, the Community began work on a plan to encourage agricultural production. The Common Agricultural Policy became operational during the 1960s.

During the period of time when Europe was occupied with its own reconstruction, other changes were occurring. Former colonies achieved independence and acquired the corresponding responsibilities for their economies. The Eastern bloc countries developed as potential food importing nations. Thus many potential purchasers of grain had non-convertible or soft currencies, or were unable to pay for the grain they needed (Wilson, 1979, p. 361-367).

In the developing world, many countries chose to intervene in the market place. The purpose of their interventions ranged from price stability to welfare concerns. The green revolution of the 1960s produced seed varieties which would grow under what were previously unfavorable conditions in the third world. These new varieties required increased application of fertilizer and extensive irrigation systems to grow, but yields were sufficiently high to bring the agricultural system of many countries beyond the subsistence level. Improved agricultural production was in turn responsible for some of the rural to urban shift in the developing world. Many developing countries also took a slightly different approach. They adopted low

food price policies to feed the new generation of urban workers. Often low farm prices discouraged domestic production and led to even more people shifting to the cities. Consequently, either through improved technology releasing workers from agriculture or deliberate policy moves by governments in developing nations or some combination, consumption patterns were changed. Some countries which were formerly net food importers, became net exporters. Other countries became increasingly reliant on food aid or commercial imports.

Baking technology, as well as production technology, became an important factor during the 1960s. New processes enabled bread production with lower protein wheats and consequently encouraged European production.

In the developed world, governments were also acting to soften the rural to urban shift and provide farm families with a reasonable level of income. This intervention through farm programs kept production levels high and ensured grain surpluses. Wheat and wheat products have been subject to more policy interventions than most food products, because with the relatively few steps in processing, and in some cases, distinct producing regions, wheat is relatively easy to control (Byerlee, 1985, p. 20).

In the post-war years, the emphasis was not only on domestic market intervention. A number of multilateral organizations and agreements sprang up. Under United Nations' auspices, the Food and Agriculture Organization (F.A.O.) was formed to provide an avenue for moving surplus grain to needy areas.

The Commonwealth countries developed the Colombo Plan to provide aid and technical assistance to their newly independent member nations. It was later expanded to include recipients and donors who were not part of the Commonwealth (Wilson, 1979, p. 363). The United States of America (U.S.A.) developed the European Recovery Program or the Marshall Plan, as it is commonly called, to aid in the reconstruction of Europe. The plan had the goals of encouraging intra-European trade and stabilizing domestic finances in the countries of Europe. Between 1947 and 1951, European production of foodstuffs increased by 24 per cent (*The Universal Standard Encyclopedia*, 1954, p. 2975-2977).

The United States (U.S.) also led the way in providing concessional sales or food aid to needy nations. In 1954, they enacted Public Law 480. Prior to World War II, the United States had approached the problem of surpluses through production controls. Temporary domestic shortages during each world war and after World War II led the American administration to look for alternative solutions to the surplus problem. This concern, along with humanitarian motives resulted in Public Law 480. Under Title I of the law, sales are made for local currencies which are in turn used to finance projects of mutual military advantage, development projects in the recipient country, or to repay American obligations abroad. Credit at concessional interest rates can also be provided. Title II provides for food aid donations and Title III allows for the barter of United States' agricultural commodities for strategic materials (Wilson, 1979, p. 366-67). Pubic Law 480 has been important, not only in providing food aid to developing nations, but also for developing markets for the Americans. Consumers who had not traditionally been wheat eaters found they liked white leavened bread. As incomes in the developing countries rose, wheat continued to be an important part of the average diet. An example is Nigeria which formerly received wheat and wheat flour at subsidized rates under Public Law 480 (U.S.D.A., 1974). Wheat was the largest food import into Nigeria until 1987, when the country banned wheat imports in order to boost local production and conserve foreign exchange (*World Grain*, September/October 1984, p. 41-43; Reuters, October 10, 1989). Soon after the enactment of Public Law 480, the encroachment of food aid programs on commercial markets became a problem.

Canada's contributions to the development of the third world has been through both multilateral and bilateral channels. Canada has been involved in the Columbo Plan, United Nations' programs, and the World Bank amongst other organizations. Canada channels bilateral aid, formerly through the former Department of Trade and Commerce, and now through the Canadian International Development Agency. In trade endeavors, the Export Credit Insurance Corporation has assisted Canadian firms by eliminating the risk of non-payment in both credit and non-credit sales (Wilson, 1979, p. 369-370).

Credit has been extended by Canada to wheat buyers since 1952/53. For terms of less than three years, funds are provided by the chartered banks at preferred rates because the federal government guarantees the loan. Flour exports are guaranteed only to the value of the wheat; the cost of any value added is a risk which must be borne by the miller. For longer periods, loans are provided through the Export Development Corporation and may be subsidized. There have been no new commitments for long term credit since 1972, possibly due to the time consuming and difficult nature of the process (I.W.C., January 20, 1983; R.I.E., 1984, p. 9).

Another change in the market structure took place through a series of multilateral agreements called the International Wheat Agreements. There were eight agreements spanning the period between 1933 and 1971, but only six of these agreements were adhered to and were reasonably effective in influencing prices and supplies in the world market. The agreements brought together producing and consuming countries in an attempt to regulate the international market. Over 50 countries were involved in the agreements covering between 80 and 90 per cent of the wheat traded (Miner, 1984, p. 13-28; Heid, 1980, p. 90).

The first three International Wheat Agreements had the stated objective of assuring "wheat to importing countries and markets to exporting countries at equitable and stable prices" (F.A.O., 1970, p. 20). Subsequent agreements added a series of more ambitious objectives:

- "to promote the expansion of the international trade in wheat and wheat flour and to secure the freest possible flow of this trade in the interests of both exporting and importing countries;
- to overcome the serious hardship caused to producers and consumers by burdensome surpluses and critical shortages of wheat;
- to encourage the use and consumption of wheat and wheat-flour generally, and in particular, so as to improve health and nutrition, in countries where the possibility of increased consumption exists; and
- in general to further international co-operation in connection with world wheat

problems, recognizing the relationship of the trade in wheat to the economic stability of markets for other agricultural products" (F.A.O., 1970, p. 20).

In addition to this, the 1968 agreement was broadened to include a food aid program for developing countries (Miner, 1984, p. 26).

As well as the stated objectives of the agreements, member countries may have had hidden objectives such as the maintenance of market share. The goals of each country or group of countries (exporters, importers, and developing coutries) may have been in conflict.

Thus, the international wheat market in the post-war era can be characterized by active government involvement in the adjustments of the marketplace, rapid technological change, and structural adjustments. New markets developed and expanded and these new consumers did not always use wheat in the same products as in the western world. High protein hard wheats were not always in demand. New producers entered the international market. The total volume of wheat traded increased, but so did instability in the market.

B. Wheat Consumption Patterns

Wheat Products

Some soft wheats and durum are produced in Canada. However, the most common types of wheats produced are hard, high protein varieties. The main product of the hard wheats is a loaf of bread which is large in volume, with a standard shape. This uniform, sliced and wrapped bread represents about 80 to 85 per cent of all bread sold (Spicer, 1975, p. 3). The crust has a pleasing colour and texture. The bread grain varies in size and shape, but none of the cells are too large or too small (Bushuk, 1982, p. 547).

All of the technical factors contribute to producing bread for Canadian consumers. In other countries, the final products might be quite different. Bread, the most common product, can be found in a number of forms. Breads may differ in taste, crust characteristics, crumb grain, volume, weight, shape, packaging and shelf life. These differences are due to the use of different grains, variations in flour content or protein, different formulations or

alternate preparation processes (Tweed, 1982, p. 673; Tipples, 1982, p. 603-604).

Wheat, of the Glenlea variety, is exported from Canada to Italy where it is primarily used in Christmas festive loaves. Rye breads are quite popular in Denmark and Germany. The Finns make oatmeal and barley breads. In the Soviet Union, many types of bread are produced from flours made from a mixture of grains[4] (C.W.B., 1985, p. 7; Tweed, 1982, p. 656-699).

Crust characteristics can be quite distinctive. Viennese bread has a thin crisp crust while Italian breads are characterized by a thick dry crust. Crumb grain and texture also vary between breads. In France, where soft wheats are grown and used in bread, the loaf has an open grain. French bread contains little or no fats, sugar or milk. This formulation produces a loaf which stales within a few hours. Consequently, French consumers often buy bread two to three times per day from small craft bakeries (Tweed, 1982, p. 656-699).

There is wide diversity in bread formulas. In North America, bread is sweeter than in Europe. American bread is approximately four times as sweet as Canadian bread (Tweed, 1982, p. 656-699). The type of bread pan used (either open or lidded) or the type of hearth makes different breads. In rural Greece, some bread is still baked in mud beehive ovens. In the urban areas the bread is usually sliced and toasted before sale, to lengthen its shelf life in the summer heat (Tweed, 1982, p. 656-699).

In China, where many medium hard, medium protein wheats are produced, a form of steamed bread is made. High or low protein wheats produce steamed bread with an undesirable shape or texture. Red wheats result in unappealing dark flecks on the surface of the loaf. Therefore virtually all of the Chinese bread flour is produced from white wheat varieties. Steamer ovens rather than baking ovens are used, in part, because they conserve fuel, which is in short supply (Ulrich and Furtan, 1984, p. 3-4).

China is not the only country to prefer white kernels. In Russia "top-grade flour must be 'white or creamy tinted'". To obtain this type or colour, red wheat flours are mixed with white Russian varieties (*Milling and Baking News*, June 1986, p. 59-60). Wheat may also be

---

[4]Mixed flour is called meslin or composite flour.

used in products other than bread. In China, wheat is also used to make noodles and dumplings. In the Middle East cereals are used to make porridge, bulgor[5] or couscous[6].

Roady flour[7] is used in baking the flat breads prevalent in the Middle East, India, and other parts of the world. Due to the French influence in Arab coutries, French style soft wheat breads are also commonly eaten.

Some breads are produced from grains other than wheat. However, the amount is a relatively small portion of all the breads produced. Alternative uses, such as noodles and porridge, can more easily be adapted to other cereal grains. In these instances, the substitution is not only between wheat varieties but between cereal grains (Personal conversation with Dr. T. Manning; Tweed, 1982, p. 656-699).

Bread Retailing

Bread production and retailing customs around the world range from small craft bakeries catering to local tastes, to large production lines shipping out a standard product. More than 90 per cent of the bread sales in France are from small bakeries because of the quick staling properties of French bread. Craft bakeries are common to most of Western Europe and Scandinavia. This market structure lends itself to the production of specialty breads. West Germany produces approximately 250 varieties of bread. Adoption of new technology in European bakeries has been slow due to their small size. However, legislation requiring that night shift workers be paid a premium has more recently encouraged the adoption of faster mixers and freezing systems. The production of low protein wheats in the European Community has also affected the structure of the processing and retail market. In the United Kingdom, the majority of bread is produced by the Chorleywood process. This process involves large volumes of bread being produced in a highly mechanized system

[5]Bulgor is wheat which is boiled, then hand, stone or mill ground to remove the bran before the mixture is sun dried. It is steamed or prepared with oil, meat or broth for consumption.
[6]Couscous is prepared from semolina which is dampened, molded into spheres and dried for future use or steam cooked for immediate consumption.
[7]Roady flour is a coarser flour which includes some of the middlings and bran from the grain reduction process.

(Tweed, 1982, p. 656-699).

State owned bakeries in Eastern Europe favour highly mechanized processes. Czechoslovakia has totally adopted the continuous mixing process (Tweed, 1982, p. 656-699). In the United States, 90 per cent of bread and baked goods comes from large and medium size bakeries which have adopted some aspects of the modern, mechanized systems. The continuous process has not found favour in Canada, possibly because of consumer resistance to the characteristics of the bread produced (Tweed, 1982, p. 656-699).

In the rest of the world, the adoption of a particular type of western bread and the associated process appears to be linked to colonial and trade ties. For example, authentic French bread is popular in Japan. But there are also large modern bakeries producing pullman[1] bread. Bread in Japan is often sold in packets of eight slices, rather than as a whole loaf (Tweed, 1982, p. 656-699).

Economic development has an effect on the type of retail establishments and on the product demanded. Urbanization results in the population being in close proximity to markets. With the shift of the population from rural areas, transportation and other types of infrastructure develop. The process of urbanization and development in turn allows large centralized production facilities to become more viable. Other effects of economic development include a more highly educated and skilled workforce able to handle complicated, large scale equipment and a rising real wage rate for workers. Consumer preferences change in favour of convenience foods and improved quality and packaging. The demand for baked goods in Bangladesh and Pakistan is less than 10 per cent of the total demand for flour and baked products. The demand for baked goods in the United States and Turkey exceeds the demand for flour at a ratio of more than nine to one. Ready to eat wheat products replace flour at a relatively early stage of development and at a low level of consumer income (C.I.M.M.Y.T., 1985, p. 2-3).

Another change in the market which takes place as incomes rise and women enter the workforce is the increased consumption of bread products outside the home. For example,

[1]Sandwich shape loaves

about 20 per cent of bread production in Britain is consumed in restaurants (*World Grain*, November/December, 1983, p. 28).

Consumption Patterns

As incomes rise there is an increase in retail demand for flour in the developing world. The demand for bakery products is also positively related to incomes and highly elastic. Therefore, many bakers in developing countries target the higher income specialty market. However, the demand curves for bakery products and flour are kinked. As net receipts rise past a certain point, bakery products continue to be positively related to income, but the demand for flour becomes negatively correlated with income. Finally at very high levels of consumer income, as found in much of the developed world, the demand for bread is income inelastic. The overall demand curve for wheat is very price and income inelastic; in the developing world, a one per cent increase in real income results in an increase in per capita consumption of 0.5 per cent. The demand curve is more uncertain at the upper end of the income scale due to the increased use of wheat as animal feed (C.I.M.M.Y.T., 1981, 1983, and 1985).

The developing world has shown the greatest expansion in wheat utilization. Between 1979-80 and 1984-85, wheat consumption in the developing world accounted for a 10 per cent increase in total world wheat usage. Since the introduction of wheat products to developing nations, these products have found growing acceptance, displacing rice, cassava and other starches in the diet of the populace. The relative price of wheat to these other starches has been an important factor. About 60 per cent of total wheat traded internationally is imported by the developing world (C.I.M.M.Y.T., 1985, p. 1 and 18).

Bread consumption per capita in the western world has been declining for over 40 years (Fisher, March/April, 1983, p. 24). An extreme example is Belgium where consumption has been declining by as much as three per cent per year (Tweed, 1982, p. 661). Consumers have continued to substitute animal protein, and fats and oils, for starches, in their diet (Veeman and Veeman, 1984, p. 31). Mary Douglas, a sociologist, tried to explain the increase

in fats and oils usage by describing food consumption as being highly related to rituals and ceremonies. There is a tendency to try and consume a greater quantity of food at rituals and in order to do this, more fats and oils are required (Douglas, 1975). This explanation probably ignores the degree of processed foods in western diets. Processed foods appear to use greater quantities of fats or oils. Whatever the reason, if this trend continues, further shifts in the patterns of wheat consumption can be expected.

Countries in the Middle East and North Africa receive a higher percentage of their caloric intake from wheat, than any region in the world. Wheat accounts for nearly three quarters of the calories from cereals and over half of the daily daily caloric intake in this region. Eastern European countries and Russia consume relatively large quantities of wheat per capita, but much of this is feed wheat used in livestock production (C.I.M.M.Y.T., 1981, p. 5). For the Soviet Union, bread consumption is approximately 135 kilograms per capita of which 80 per cent is wheat bread (Tweed, 1982, p. 679). In the developed countries of Europe and North America, as well as Japan, Australia and South Africa, approximately 60 per cent of staple calories come from wheat. The lowest wheat consumption can be found in central Africa where wheat represents less than 10 per cent of staple calories.

The effect of incomes and the distribution of income is illustrated by the countries of the Middle East and the developed market economies versus the less developed countries and the state controlled economies. In the former, expenditure on bread tends to be a very small fraction of per capita income. This affects consumption. For example, in France, one kilogram of bread costs less than one per cent of weekly per capita income, and wheat provides about 77 per cent of staple calories. In the Sudan, a less developed region, to buy the same amount of bread requires approximately 12 per cent of weekly per capita income, and wheat represents only 15 per cent of base level caloric intake. In Canada, consumers spend only 0.7 per cent of their disposable income on bread and 1.8 per cent on all cereal products (or 9.6 per cent of their food budget) (Statistics Canada, 62-553, 1985).

In areas such as Malaysia where rice and wheat are substitutes, the high price of wheat in relation to rice may discourage wheat consumption. In other third world countries,

such as India or the Dominican Republic, where wheat and rice prices are quite similiar, there are somewhat higher levels of wheat in the local diets. In developed countries, rice prices are higher than wheat prices and the relative prices are probably not a factor in wheat consumption. There is also a tendency for producing countries to be larger consumers of wheat than non-producing areas (C.I.M.M.Y.T., 1985, p. 24-40).

Trends in Wheat Consumption

In the developed world, food wheat utilization is fairly stable and growth in these markets is largely linked to population growth. In the developing world, the demand for food wheat is expected to grow. Even during the financial crisis of the 1980s, most of the less developed countries continued to expand wheat imports. The population in the developing world is growing at a rate of approximately two per cent per year. This factor, along with rises in real income, is expected to translate into an increase in consumption of one and one half to two per cent per annum. If the rate of population growth in the developing world was to revert to former levels, the increase in wheat consumption could be as high as four to five per cent per year (C.I.M.M.Y.T., 1985, p. 17-18).

Urbanization is another trend in the third world. By the year 2000, about 40 per cent of the population in these areas will be in cities. The move to urban living and the encumbent changes in lifestyle will probably increase wheat consumption. In fact the estimate is that urban dwellers in the third world will account for approximatley 50 per cent of global wheat consumption by the year 2000 (C.I.M.M.Y.T., 1985, p. 1).

While many developing countries are trying to reduce the level of domestic subsidies, the process is slow. No near term effects on wheat utilization are likely (C.I.M.M.Y.T., 1985, p. 17). However, if the current General Agreement on Tariffs and Trade (G.A.T.T.) round of discussions is successful in reducing agricultural support levels, and results in lower levels of surplus stocks, higher prices should be maintained. This might inhibit demand in the developing world depending on whether or not food aid shipments are increased.

III. A Transportation Model for Flour

A. The Purpose of the Transportation Model

The function of transportation in marketing is to add place utility to goods. A by-product of transportation is time utility. Transportation costs help to determine geographic price relationships, the availability of markets to particular suppliers, and the location of production, processing, and storage facilities. In this chapter, a simple linear transportation model is used in an attempt to assess the least cost pattern of trade (subject to available data on freight costs). This will be compared to available data on actual trade flows. The purpose of using this model is to attempt to explain patterns of trade in flour and to discuss possible market opportunities and restrictions.

B. Freight Rate Estimation

A full set of reliable data on actual freight rates for shipping flour was not available. Therefore the assumption was made that bulk grain rates and containerized flour rates maintain the same relative cost relationship on all routes. This assumption was then applied in estimating the freight rates used in the model. Given that there is some substitutability between the liner and non-liner ocean shipping markets,[9] this assumption of similar price movements should hold in general, although in specific instances the assumption may be violated. The model excludes the situation where time or trip charters are used to ship large

[9]There are two basic types of transport ships; liners and non-liners. The latter include bulk carriers, tankers and tramp vessels and currently move about "94 per cent of the total volume of dry and liquid bulk" (Wei, 1985, p. 10). Liners move about 92 per cent of the containerized foods. Commodities which fall into neither the bulk or containerized category are called neo-bulk and are moved by both liners and non-liners (Wei, 1985, p. 9-10). The industry is further divided into conference and non-conference vessels. Conferences are organizations of firms which set rates, rationalize capacity and control competition. Conference liners follow fixed routes and schedules. Non-conference liners, as their name implies are independent operators. Their rates are usually less than conference rates. Tramps are vessels which are chartered on a time or trip charter basis. They do not have regular routes and their rates are determined in the open market. Since the tramp rates are usually a whole ship rate, they are generally lower than liner prices, but liner rates are usually more stable (Wei, 1985, p. 9-10, 24, 81). Flour would usually be a containerized good which might move on conference or non-conference vessels.

quantities of flour to a single destination; a situation which occurs in the real world. Ocean freight rates for grain were obtained from various issues of the International Wheat Council's *World Wheat Statistics*. Since the rates given were only for a sample of possible routes, regression analysis was used to estimate total cost as a function of distance for the remaining routes. There are many other factors involved in the setting of actual rates such as port charges, the volume of shipments, the degree of competition on a particular route, and backhaul possibilities. Due to lack of data and for purposes of simplicity, these other factors were not quantified and were instead assumed to be captured in the intercept term. Time series and cross sectional data were pooled. The regressions were done on three year averages in order to smooth some of the fluctuations in rates and to provide sufficient observations for the regressions. For the most part, class A vessels were assumed to be the mode of transport. Nine regressions were run. One applies for each source (Canada, the United States, the European Community, and Australia) for the time periods 1974/75 - 1976/77 and 1982/83 - 1984/85. Then one overall regression was run for the time period 1982/83 - 1984/85.

The results of the regressions are given in Table 1. Estimation was by the ordinary least squares (O.L.S.) procedure, using the SHAZAM computer package. All regressions for the 1982/83 - 1984/85 time period have high R^2's and the estimates of both the constant term and the independent variables are significant. From the scatterplots of the variables and the error terms there is no apparent heteroscedasticity or autocorrelation. However, both of these problems are difficult to determine due to the few observations in three out of the four cases and because of a problem with outliers. The Durbin-Watson statistic was indicating positive autocorrelation on several routes. In the 1974/75 - 1976/77 time period the regressions (with the exception of the Canadian source) have low R^2's and there are a number of cases where the constant term or independent variable coefficients were insignificant. As stated previously a problem exists with few observations and the number of outliers. For the European route there was also the possibility of heteroscedasticity. A generalized least squares (G.L.S.) procedure for pooled data was then used. There was little improvement in the R^2 for the 1974/75 - 1976/77 time period and three terms remained insignificant.

Table 1
Analysis of the Transport Cost Regressions for Different Sources and Time Periods

Freight Rates	OLS Estimates No. of observations	R^2	Constant	Distance	GLS Estimates Buse adjusted R^2	Constant	Distance	Data
1982/83 - 1984/85								
Canada	27	0.90	C = 2.5656	+ 0.0012d	0.90	C = 2.3329	+ 0.0013d	-few observations
			(2.19*)	(15.25*)		(3.07*)	(13.63*)	-scatter plots do not appear to have hetero-scedasticity or autocorrelation, no outliers
United States	84	0.66	C = 4.6550	+ 0.0011d	0.61	C = 7.3885	+ 0.0009d	-no apparent heteroscedasticity or autocorrelation
			(3.24*)	(12.55*)		(4.94*)	(11.14*)	-few outliers lying outside 2 standard deviations from the mean
Europe	15	0.97	C = 12.5740	+ 0.0007d	0.97	C = 12.3100	+ 0.0007d	-few observations
			(20.39*)	(19.94*)		(17.31*)	(18.01*)	-no apparent heteroscedasticity or autocorrelation
								-quite a few outliers
Australia	24	0.52	C = 15.1680	+ 0.0004d	0.51	C = 14.6900	+ 0.0004d	-few observation
			(12.62*)	(4.93*)		(8.84*)	(4.29*)	-no apparent heteroscedacity or autocorrelation
								-no outliers
1974/75 - 1976/77								
Canada	24	0.69	C = 2.9667	+ 0.0008d	0.70	C = 3.6247	+ 0.0008d	-few observations
			(1.56***)	(6.92*)		(1.80**)	(6.41*)	-slight heteroscedasticity
								-few outliers
United States	78	0.46	C = 3.5513	+ 0.0009d	0.46	C = 4.1642	+ 0.0008d	-no apparent heteroscedacity or autocorrelation
			(1.92**)	(8.13*)		(2.22*)	(7.85*)	-few outliers
Europe	12	0.15	C = 16.1050	+ 0.0005d	0.16	C = 17.1180	+ 0.0004d	-few observations
			(2.32*)	(1.33)		(2.23*)	(1.09)	-heteroscedasticity possible, no outliers
Australia	21	0.04	C = 17.8160	+ 0.0002d	0.16	C = 16.1030	+ 0.0003d	-few observations
			(5.98*)	(0.89)		(6.18*)	(1.65***)	-no apparent heteroscedasticity or autocorrelation
								-few outliers
1982/83-1984/85								
All	150	0.67	C = 7.0268	+ 0.0009d	0.63	C = 8.7153	+ 0.0008d	-no apparent heteroscedacity or autocorrelation
			(8.03*)	(17.40*)		(8.24*)	(15.60*)	-some outliers

Notes:
*** significant at 80% confidence level
** significant at 90% confidence level
* significant at 95% confidence level
t - statistics are in brackets
C denotes cost
d denotes distance

It was decided to drop the 1974/75 - 1976/77 time period from consideration. The relationship between distance and freight rates was weak. This situation may be explained by factors occuring during the time period being considered. In the early 1970s a series of rate wars occurred between the various conferences and freight rates in general tended to fluctuate under the intense competition.

Since the generalized least squares procedure corrected for autocorrelation and heteroscedasticity which may have been present, the results of the equations generated using this procedure were used to calculate freight rates for the 1982/83 - 1984/85 time period. When generating the freight rate for a particular route, the closest port, at the source, to the destination was used to calculate distance. Since the regressions were not run by port due to insufficient data, the assumption was made that port charges at the source are equal for all possible ports. For Canada, this meant that Vancouver was used as a source for some destinations such as in the Asia-Pacific region, even though all data used for the regression was for shipments via the St. Lawrence. A centralized city in terms of location was used as the representative destination for each region. Where actual freight rates were available, an average of the rate over the three year period was used in preference to the calculated rate.

C. The Transportation Model

The transportation model was formulated for solution using the MPS/360 computer package (I.B.M., 1969). This linear programming model may be solved using the simplex procedure. The model was contructed assuming that flour is a homogeneous product. Supply and demand are fixed and equated, if necessary as in this case, by the use of a dummy destination. The model was restricted to only allows goods to be transported directly via the prescribed route. Therefore flour could not be shipped from Canada to the United States and then on to the Philippines. It was assumed in the model that all flour was shipped using the prescribed route. For example shipments of flour from the European Community via train to the Soviet Union or containerized shipment on a liner calling in at a number of ports were not considered.

The given level of requirements for each of the eleven destinations was calculated as the three year average of the imports from the four suppliers. The four suppliers account for close to 90 per cent of the world trade in flour. The supply was calculated as 20 per cent in excess of the amount of flour actually exported by the big four exporters. This allowance for excess capacity was made to allow some flexibility in supply availability. There is excess capacity of over 20 per cent in the milling industries of the exporting countries.[10] By allowing for potential production capability in the model, the assumption was that the marginal cost of the excess capacity is the same as the marginal cost of the existing level of output. This assumption affected the values of the dual activity reported in the equilibrium cost matrix shown later in this chapter. The surplus supply is captured in a dummy destination. Transport costs for the four dummy routes were arbitrarily set at the prohibitively high cost of $40. This choice influenced the absolute value of the shadow prices.

The data on trade volumes in wheat flour are aggregates of soft and hard flour shipments. This aggregation violates the assumption in linear programming of a homogeneous product. The possible effect of this assumption becomes apparent later in trying to explain deviations in trade patterns from the estimated optimum. In terms of specifications of the model, it was assumed that the European Community supplied all of the soft wheat flour required in Europe, and none of the hard wheat flour. It was also assumed that Canada, the United States and Australia supply all the hard wheat flour requirements of Europe. Therefore the import requirements by Europe exactly equal imports from these three producers, and the European Community was restricted from supplying any of this flour.

The problem can be specified, in a form which allows solution by the simplex method,[11] following Dorfman, Samuelson, and Solow (1958), as follows:

Minimize $T=\Sigma_i \Sigma_j C_{ij} X_{ij}$ $\quad i=1,2,3,4 \quad j=A,B,C...L$

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[10]According to Statistics Canada, Canadian utilization rates were about 72 per cent in the early 1980s (Statistics Canada 22-502, 1985, p. 22). The utilization rates of some European Community countries were far below this. The United States and Australia also suffered from low capacity utilization (R.I.E., 1984, p. 8).

[11]Note that this method is different from the commonly used transportation algorithms.

where X_{ij} denotes tonnes of flour shipped from source i to destination j,

C_{ij} denotes transportation cost per tonne in American dollars, and

T denotes total cost of transportation on all routes.

Subject to the restrictions:

$\Sigma_i X_{ij} = k_i \quad i = 1,2,3,4$

where k_i denotes the estimated milling capacity of country i.

$\Sigma_i X_{ij} = r_j \quad j = A,B,C...L$

where r_j denotes the flour requirements of country j.

$X_{ij} \geq 0 \quad i = 1,2,3,4 \quad j = A,B,C,...L$

D. Results of the Transportation Model

Table 2 shows the cost-flow matrix for Model 1. Actual trade flows are reported in Table 3 and the optimal flows are reported in Table 4. In the optimal solution Canada emerges as a major supplier for the Middle East / North African region. All the wheat Canada can supply goes into this market. One reason why this trade pattern is not, in practice, the case maybe that North Africa mills wheat to very high extraction rates since mainly flat breads are produced from the flour. Exporters to the region who produce white wheats may mill these wheats at higher extraction rates and sell the resultant flour at a lower cost. As well, soft wheat flours would not be discriminated against and this could also make the higher priced Canadian flour less competitive. Another factor which may explain the deviation between optimal and actual flows is that the United States and the European Community supply a great deal of the flour in the region under subsidy programs.

Most Canadian flour exports actually go to China, the Soviet Union, and the Caribbean / Central America region. In the model, the requirements of these regions are met by the United States. The reasons for the actual lack of a significant market share by the United States may be political. For example, Cuba is a significant importer in the Caribbean / Central American region, but the United States does not trade with Cuba. This premise is also

Table 2
Model 1 and 3 Transportation Rates 1982/83 - 1984/85
(American dollars per tonne of flour)

	IMPORTING REGIONS												
Exporting Regions	Europe	North Africa & Middle East	West Africa	South Asia	South East Asia	East Asia	U.S.S.R.	Caribbean & Central America	East Africa	East South America	West South America	Dummy Destination	Total Exports (tonnes)
Ports	Rotterdam	Egypt	Cameroon	India	Philippines	China	Black Sea	Cuba	Tanzania	Brazil	Peru		
Canada	9.78	*16.20	*15.99	*31.77	*20.89	*19.23	13.81	*9.16	*27.08	*15.56	*15.13	40.00	491.64
U.S.A.	11.74	19.98	*16.91	29.42	17.95	17.21	15.35	*8.50	*36.86	*16.91	*12.47	40.00	2041.04
E.C.	N/A	18.83	*19.36	28.06	*32.97	*33.70	*17.90	*19.60	*25.07	*20.09	*22.52	40.00	3919.00
Australia	*25.85	22.67	*22.55	23.04	16.80	17.65	*26.65	*26.12	*20.00	*23.29	*20.74	40.00	95.56
Total Imports (tonnes)	55.83	3123.26	538.00	174.57	68.77	67.29	225.27	358.53	506.37	9.03	85.27	1335.05	6547.24

Notes:
* estimated
N/A - not applicable
Source:
International Wheat Council, ***World Wheat Statistics***, London, various issues.

Table 3
Actual Shipments of Wheat Flour 1982/83 - 1984/85
(thousand tonnes of flour)

	IMPORTING REGIONS												
Exporting Regions	Europe	North Africa & Middle East	West Africa	South Asia	South East Asia	East Asia	U.S.S.R.	Caribbean & Central America	East Africa	East South America	West South America	Dummy Destination*	Total Exports (tonnes)
Ports	Rotterdam	Egypt	Cameroon	India	Philippines	China	Black Sea	Cuba	Tanzania	Brazil	Peru		
Canada	9.73	17.46	11.93	7.40	0.50	60.23	41.97	209.17	36.74	2.33	3.47	90.71	491.64
U.S.A.	46.07	1080.80	26.90	143.10	25.47	1.00		59.53	239.43	1.24	48.53	368.97	2041.04
E.C.	N/A	2021.90	480.87	18.30	35.40	0.23	183.30	89.83	223.60	5.46	33.27	826.84	3919.00
Australia	0.03	3.10	18.30	5.77	7.40	5.83			6.60			48.53	95.56
Total Imports (tonnes)	55.83	3123.26	538.00	174.57	68.77	67.29	225.27	358.53	506.37	9.03	85.27	1335.05	6547.24

Notes:
Since no "other" category was allowed for exports or imports from/by unspecified regions, the total exports column and total import row represent the sum of the respective entries in the matrix. A complete data set is provided in the tables in Chapter IV. Calculation methods were also slightly different between the two models resulting in rounding differences.
The actual shipping pattern represented a total transportation cost of $104,336,480.
N/A - not applicable
* Note that the assumed 20 per cent overage in supply for each exporter was calculated based on exports to all regions, not just those included in this model.
Source:
U.S.D.A., *Foreign Agriculture Circular - Grains*, December 1986.

Table 4
Model 1 Estimated Least Cost Trade Flows 1982/83 - 1984/85
(thousand tonnes of flour)

	IMPORTING REGIONS											
Exporting Regions	Europe	North Africa & Middle East	West Africa	South Asia	South East Asia	East Asia	U.S.S.R.	Caribbean & Central America	East Africa	East South America	West South America	Dummy Destination	Total Exports (tonnes)
Ports	Rotterdam	Egypt	Cameroon	India	Philippines	China	Black Sea	Cuba	Tanzania	Brazil	Peru		
Canada		491.64											491.64
U.S.A.	55.83		538.00		68.77	67.29	225.27	358.53		9.03	85.27	633.05	2041.04
E.C.	N/A	2631.62		174.57					410.81			702.00	3919.00
Australia									95.56				95.56
Total Imports (tonnes)	55.83	3123.26	538.00	174.57	68.77	67.29	225.27	358.53	506.37	9.03	85.27	1335.05	6547.24

Notes:
The optimal solution represented a total transportation cost of $94,493,530 (excluding the dummy destinations); compared to actual routing this is a $9,842,950 cost saving.
N/A - not applicable
Source:
MPS/360 Computer Printout, Section 1 - Rows and Section 2 - Columns.

borne out by the fact that the European Community ships a moderate quantity of flour to the region. The European Community ships flour to a number of markets such as West Africa, South East Asia and Western South America which would not have been expected given the location of these markets relative to the supplier. However, colonial trading ties, political preferences by trading partners, and subsidy programs may explain some of these trade flows. The same rationales may explain American shipments to South Asia and East Africa.

Australia exports small quantities of flour to a number of regions not specified in the optimum solution. This pattern of trade flows may be due to a preference in the importing regions for white wheats. Another reason for deviations from the optimum in the model may be the relatively low cost of these changes. The actual pattern of trade flows only costs $9,842,950 more than the optimal solution or an additional 10 per cent of total transportation cost. This final point, of course, arises from the assumption used in the model that the actual freight rates for flour are quite similar to the freight rates for wheat.

In view of the long distances from Canada to some major markets, it is of interest to see the effects on the pattern of trade if competitive conditions in the ocean freight market were to change such that freight rates in general became more closely related to distance. This situation was modelled as Model 2. Using the overall regression for all four suppliers, freight rates were generated (see Table 5). This analysis assumed consistent port charges for all suppliers. The results of Model 2 are reported in Table 6. Under these conditions, Canada's position in the world market deteriorates and it supplies only a small portion of current capacity to the European market. The United States would optimally ship flour to South Asia and East Africa, but ship less flour than in Model 1 to the European, West African and Soviet markets. American suppliers would lose some of their market share to the European Community. The Community gains an advantage in the North African / Middle Eastern, West African, and Soviet markets and loses potential advantages in the South Asian and East African destinations. Australia's advantage shifts from East Africa to South Asia.

A third model was constructed to assess the optimal pattern of trade given the transportation costs used in the first model, but under a series of restrictions designed to more

Table 5
Model 2 Transportation Rates Based on a Common Intercept Term 1982/83 - 1984/85
(American dollars per tonne of flour)

	IMPORTING REGIONS												
Exporting Regions	Europe	North Africa & Middle East	West Africa	South Asia	South East Asia	East Asia	U.S.S.R.	Caribbean & Central America	East Africa	East South America	West South America	Dummy Destination	Total Exports (tonnes)
Ports	Rotterdam	Egypt	Cameroon	India	Philippines	China	Black Sea	Cuba	Tanzania	Brazil	Peru		
Canada	15.20	17.50	17.37	27.37	20.48	19.42	17.91	13.04	24.40	17.10	16.83	40.00	491.64
U.S.A.	15.48	17.64	23.86	25.48	20.07	17.36	18.18	9.66	23.45	16.83	13.04	40.00	2041.04
E.C.	N/A	14.39	16.56	25.70	31.69	32.50	14.93	16.82	22.91	17.37	20.07	40.00	3919.00
Australia	31.16	30.42	24.53	18.04	15.20	16.82	32.77	31.69	19.40	26.02	20.88	40.00	95.56
Total Imports (tonnes)	55.83	3123.26	538.00	174.57	68.77	67.29	225.27	358.53	506.37	9.03	85.27	1335.05	6547.24

Notes:
N/A - not applicable
Source:
Estimated using the regression equation for all sources.

Table 6
Model 2 Estimated Least Cost Trade Flows Using Transportation Rates Based on a Common Intercept Term 1982/83 - 1984/85
(thousand tonnes of flour)

	IMPORTING REGIONS											
Exporting Regions	Europe	North Africa & Middle East	West Africa	South Asia	South East Asia	East Asia	U.S.S.R.	Caribbean & Central America	East Africa	East South America	West South America	Dummy Destination	Total Exports (tonnes)
Ports	Rotterdam	Egypt	Cameroon	India	Philippines	China	Black Sea	Cuba	Tanzania	Brazil	Peru		
Canada	55.83											435.81	491.64
U.S.A.				79.01	68.77	67.29		358.53	473.90	9.03	85.27	899.24	2041.04
E.C.	N/A	3123.26	538.00				225.27		32.47				3919.00
Australia				95.56									95.56
Total Imports (tonnes)	55.83	3123.26	538.00	174.57	68.77	67.29	225.27	358.53	506.37	9.03	85.27	1335.05	6547.24

Notes:
Model 2 generated a total cost of shipping of $80,934,470 (excluding the dummy destinations).
N/A - not applicable
Source:
MPS/360 Computer Printout, Section 1 - Rows and Section 2 - Columns.

accurately reflect the real world. Canada was considered to be shut-out of the North African / Middle East market due to the type of wheat and flour it produces. The United States was restricted as an importer to China, the Soviet Union, and Cuba. The results of Model 3 are reported in Table 7. The optimal trade flows under these conditions seem to more closely approximate the situation in the real world than Model 1. Canada exports mainly to the Soviet Union, and the Caribbean / Central America regions. The United States becomes the major exporter to Europe and South America, while the European Community ships mainly to the North Africa / Middle East market. Some distortions of reality still apply. Because the grouping of the destinations is based on geographic considerations rather than political ties, some pairings of sources and destinations which are not restricted in the model may be actually partially restricted. For example, some countries such as Vietnam may in reality purchase from the European Community in preference to the United States but may be grouped with other countries such as the Philippines, which do purchase from the United States. Two interesting trading partners in this model are China and Australia. If the freight rates for this route are accurate, Australia has an opportunity in this traditional Canadian market.

Some tentative conclusions which may be drawn from the information are as follows:

a. The actual pattern of trade flows was not that much different from the optimum.

b. Most differences can be explained in terms of traditional trading ties, political considerations, differences in the product and subsidies.

c. While Canada was disadvantaged by subsidies from the United States and the European Community, particularly in some targeted markets, it benefits (as do other suppliers) from United States' policies which restrict trade with certain countries and the negative perception of the United States in some nations which results in limited purchases of American goods.

Sensitivity analysis was performed on Model 3 and the results are given in Appendix C. It showed that shipments by Australia are very insensitive to freight rate changes, as are Canadian shipment patterns. Under certain conditions the Chinese and European markets

Table 7
Model 3 Estimated Least Cost Trade Flows With Restricted Trading Patterns 1982/83 - 1984/85
(thousand tonnes of flour)

	IMPORTING REGIONS												
Exporting Regions	Europe	North Africa & Middle East	West Africa	South Asia	South East Asia	East Asia	U.S.S.R.	Caribbean & Central America	East Africa	East South America	West South America	Dummy Destination	Total Exports (tonnes)
Ports	Rotterdam	Egypt	Cameroon	India	Philippines	China	Black Sea	Cuba	Tanzania	Brazil	Peru		
Canada		•					133.11	358.53					491.64
U.S.A.	55.83		538.00		68.77	•	•	•		9.03	85.27	1284.14	2041.04
E.C.	N/A	3123.26		174.57			92.16		478.10			50.91	3919.00
Australia						67.29			28.27				95.56
Total Imports (tonnes)	55.83	3123.26	538.00	174.57	68.77	67.29	225.27	358.53	506.37	9.03	85.27	1335.05	6547.24

Notes:
Model 3 represented a total transportation cost of $96,423,960 (excluding the dummy destinations); compared to actual routing this is a $7,912,520 cost saving and compared to the unrestricted optimum (Model 1) a $1,940,430 cost saving.
• - Shipment restricted
Source:
MPS/360 Computer Printout, Section 1 - Rows and Section 2 - Columns.

open up to Canada. The United States and European Community rates were the most sensitive to change with small changes in each others' rates causing a corresponding loss in trade volumes and changed patterns of shipments.

E. Problems with Spatial Price Equilibrium Models

While this transportation model, when restricted, appears to explain some of the international trade flows in wheat flour, the model's usefulness has been restricted by several assumptions. These include:

a. fixed export supply availability and import demand requirements,
b. all trade flows are in absolute terms (i.e., importers will take all available supplies at a given price, then at a certain level of price increase shift suppliers totally),
c. a perfectly homogenous product,
d. only unit transportation cost motivate the market (although the restricted model attempts to account for this),
e. perfect certainty,
f. all factors which affect trade flows are static, and
g. perfect competition (Thompson, 1981, p. 28-36).

Supply and demand curves are not linear, countries may import some level of product from a supplier even when the cost of importing from that supplier rises, wheat flour is not a homogeneous product, perfect certainty does not exist, and there has not been perfect competition in the market. On the other hand, an attempt is made in the model to address policy issues through the restrictions, the time frame for the model is sufficiently short that differing trade conditions and uncertainty may not be as relevant, and even if the types of flour are not perfectly homogeneous, they do compete with each other. Nevertheless, the major concern with the model is its sensitivity to the coefficients derived from the data. Consequently, an alternate method of evaluating trade flows in wheat flour was contemplated.

IV. A Constant Market Share Model for Flour

A. The Purpose of the Constant Market Share Model

Another method, apart from a simple linear transportation model, to explain the patterns of trade is a market share model. In its simplest form, a constant market share model can be developed which calculates changes in trade flows and attributes these changes to distribution, competitive or size of market effects. These effects are defined as:

a. Distribution effect - importing countries change the volume of the product that they purchase, so that some markets grow more rapidly than others. Consequently, even though an exporter may maintain its market share in all markets, there may be a loss or gain in its overall market share.

b. Competitive effect - the market share of an exporting nation changes due to the loss or gain of market share in a particular market or markets.

c. Size of Market effect - the overall size of the market for the commodity expands or contracts. This effect can enhance or offset changes due to distribution or competitive effects.

The basic premise behind such a model is that each exporter's market share in each import market "will remain unchanged through time unless something happens to alter that exporter's 'competitiveness'" (Thompson, 1981, p. 37). A constant market share model has no predictive power and no normative connotation as to what the market share in a particular market ought to have been. Instead, such a model is used to attempt to explain historical patterns of trade (Rigaux, 1971).

Leamer and Stern have pointed out that demand for exports in a given market between two sources of supply can be described as:

$$q_i/q_j = f(p_i/p_j)$$

where:

q_i denotes the quantity sold by the i th exporter, and

p_i denotes the price of the commodity charged by the i th exporter.

They imply that a country's market share will remain constant except as a function of the relative price of its products to its competitor's product. By assuming an elasticity of substitution greater than one in absolute value, any change in a country's market share is attributable to relative price changes (Leamer and Stern, 1970, p. 171-183).

The constant market share model can be viewed as follows:

$$q_1/q_2 = s_1/s_2 = f(c_1/c_2)$$

where:

s_i denotes market share of the i th exporting country, and

c_i denotes the competitiveness of the i th exporting country.

The relative quantities sold of a commodity are equal to relative market shares which in turn are related to the relative level of competitiveness. For a single country, the expression is:

$$q = sQ$$

where:

s denotes market share,

q denotes exports from the country, and

Q denotes total world trade in that commodity

By taking the derivative with respect to time and explicitly recognizing the regional distribution of this country's exports, the following equation results:

$$\Delta q = s\Delta Q + [\ \Sigma_i\ s_i\ \Delta q_i - s\Delta Q\ ] + \Sigma_i\ q_i\ \Delta s_i$$

That is, a change in the quantity exported by the i th exporting country is the sum of the change in the size of market ($s\Delta Q$), the distribution effect (the expression in square brackets) and the competitive effect (the last term in the previous equation).

Or, alternatively:

$$A_2 - A_1 = (B - A_1) + (C-B) + (A_2-C)$$

where:

A_1 and A_2 denote the actual quantities sold by the exporting country in question in each period,

B denotes the market share of the exporter which would have occurred in time period

two if the market share from time period one was applied to the total quantity shipped in time period two, and

C denotes the market share which would have occurred, had the exporting country in question maintained the same market share in time period two as in period one in each importing market.

It seems reasonable that a cross price elasticity greater than one and a heavy dependence on the price relationship may apply for flour from different sources, but other factors may also affect trade flows in flour. Given the high degree of intervention in the wheat and flour markets, price may not be the determining factor in a sale. For example, Japan has been purchasing United States wheat for food aid, in what appears to be an attempt to meet American demands for a more "equitable" trade balance. Another situation occurs when a developing nation attempts to capture the benefits of a value added processing industry by importing wheat, despite cost savings arising from flour imports. A constant market share model does not elucidate the source of competitiveness but can provide valuable information on how markets have changed over time.

Another constraint of this market share model is the dependence on the demand side of the trade equation without explicit consideration for supplies. Consequently the loss of market share attributable to a poor crop, inadequate transportation or an embargo by the exporting nation (i.e., supply constraints) may be misinterpreted as a competitive or distribution effect. Further, the formulation of this model, like the transportation model, may be sensitive to the grouping of importing nations. The model results are also sensitive to short term fluctuations in trading patterns, but the latter factor can be offset by comparing an average of years rather than two single years in the analysis. Depending on the degree of substitutability between goods (i.e., the homogeneity or lack thereof of a commodity), the world total exports or world growth rates may not be an appropriate standard. The degree of competitiveness between exporting countries also would not be accurately interpreted if the commodity was heterogeneous. Thus the level of commodity disaggregation can influence the model results.

B. Grain Constant Market Share Models

Rigaux used a constant market share analysis to analyze Canadian wheat exports. Using a period of time during which Canadian wheat exports were falling, he concluded that Canada may have been pursuing inappropriate (shrinking) markets given his calculation that most of the effects were attributable to adverse distribution effects. Rigaux noted that further policy interpretations were difficult due to the constraints of the model (Rigaux, 1971).

Noting that the results of the constant share model are very sensitive to the time periods chosen, Veeman and Veeman applied the model to the average wheat exports for the time periods 1969/70 - 1973/74; 1974/75 - 1978/79 and 1979/80 - 1984/85. Comparing export performance over 1970 to 1974 with 1975 to 1979, the United States was found to benefit most from the size of market effect with some increase in market share attributable to competitive effects. Argentina also benefited from competitive effects while Canada and the European Community were adversely affected by losses of market share in particular markets. Australia demonstrated a small decline in competitiveness. Canada also suffered from adverse distribution effects (i.e., a concentration of exports to slow growing markets) (Veeman and Veeman, 1988).

For the 1974 to 1979 time period compared with the 1979 to 1985 time period, a gain in exports was achieved by all major exporters, due to the size of market effect, although this was proportionally less for the United States than other exporters. Distribution effects were positive for Canada and Argentina and substantially negative for the United States. Only the European Community and Argentina exhibited improved competitiveness. Veeman and Veeman went on to attribute some of these effects to the policy implications of the 1981 United States farm bill on domestic grain sales, the 1980 United States embargo on grain sales to the Soviet Union, the reorientation of Canadian and Argentinian market efforts to more rapidly growing markets, and other farm policies (Veeman and Veeman, 1988).

In 1988, Schissel applied this analysis to much longer time frames using the periods 1955/56 - 1964/65; 1965/66 - 1974/75 and 1975/76 - 1984/85. Schissel also looked at the commodity effect of substituting different types of wheat in different markets. By using a

fourth factor, the order in which the effects were calculated influenced the results. Consequently Schissel reversed the order of the calculation in order to check for any discrepancies. He reported that for the 1955/56 - 1964/65 period compared to the 1975/76 - 1984/85 period:

a. The size of market effects were significant for all major exporters.

b. The commodity effect was negative for Canada, Argentina and Australia.

c. The European Community gained the most from distribution effects although the United States and Argentina also benefited. Australia was adversely affected by distribution effects and for Canada the model was inconclusive.

d. All countries benefited from competitive effects.

Schissel used these results to suggest various policy choices which had predicated these results. For example, the concentration by Canada and Argentina on hard red wheats and Australia on medium quality wheats was given as a potential explanation for the adverse commodity effects experienced by these exporters (Schissel, 1988).

As Leamer and Stern point out, the constant market share model does not replace other forms of demand analysis which have predictive power.

C. Estimating the Constant Market Share Model

The data for the model were taken from the same December 1986 United States Department of Agriculture, *Foreign Agriculture Circular*, which provided the data for the transportation model. Imperfections in the data, which appear due to the continuous exclusion of certain countries from the import totals, were corrected. Since the data for 1985/86 were preliminary, they were excluded from the analysis. A three year average of trade flows was used for comparison purposes to limit the effects of any short term trade fluctuations. Consequently, the time period under consideration was 1973/74 - 1975/76 compared to 1982/83 - 1984/85. The Lotus 1-2-3 spreadsheet computer package was used to make the calculations.

Obviously the results of the model are very dependent on the time frame chosen for consideration and data availability has been a constraint. However, there is no reason to believe that the time period under analysis is in any way unusual, except that it covers a period of extended world market growth.

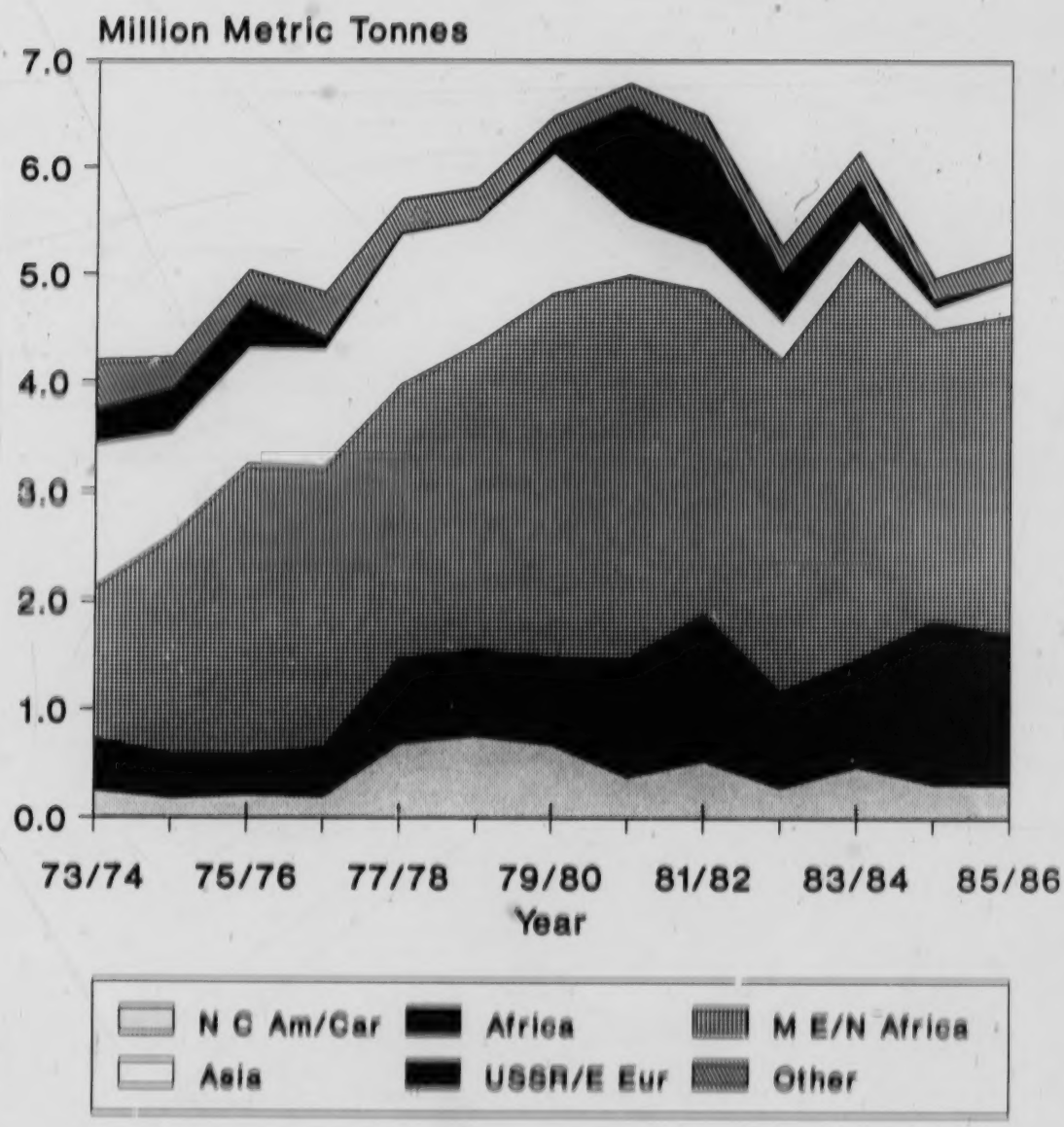
D. Results of the Constant Market Share Model

Between 1973/74 - 1975/76 and 1982/83 - 1984/85, the world flour market grew by approximately 975,140 metric tonnes. The areas of greatest growth were the North American market (essentially the Caribbean and Central American regions), and the African and the Middle Eastern markets. Modest growth occurred in South American markets. Increases in Eastern European imports were offset by decreases in Soviet imports. Asia, Western Europe and Oceania declined in relative importance as importing regions (Graph 6).[12]

For Canada, the patterns of trade were somewhat different. The Canadian share of Caribbean and Central American, African and Middle East markets grew. The Canadian market share in Western Europe increased. Starting from the relatively small base of 2,870 metric tonnes, Canada almost doubled its exports to South American markets. Overall, imports by Asia shrank by about 72 per cent, but the Canadian flour market in Asia shrank by only about 52 per cent. Canada's biggest loss was in the Soviet market. Canada had 100 per cent of that market in 1973/74 - 1985/76. However, by 1982/83 - 1984/85, its market share had dwindled to less than 19 per cent of this shrinking market. This meant that for the time period under consideration, the overall Canadian market share declined from about 14 per cent to about eight per cent. In absolute terms this decline represented an average of 236,730 fewer tonnes being shipped annually in 1982/83 - 1984/85 than in the earlier time period (Graph 7 and Table 8).

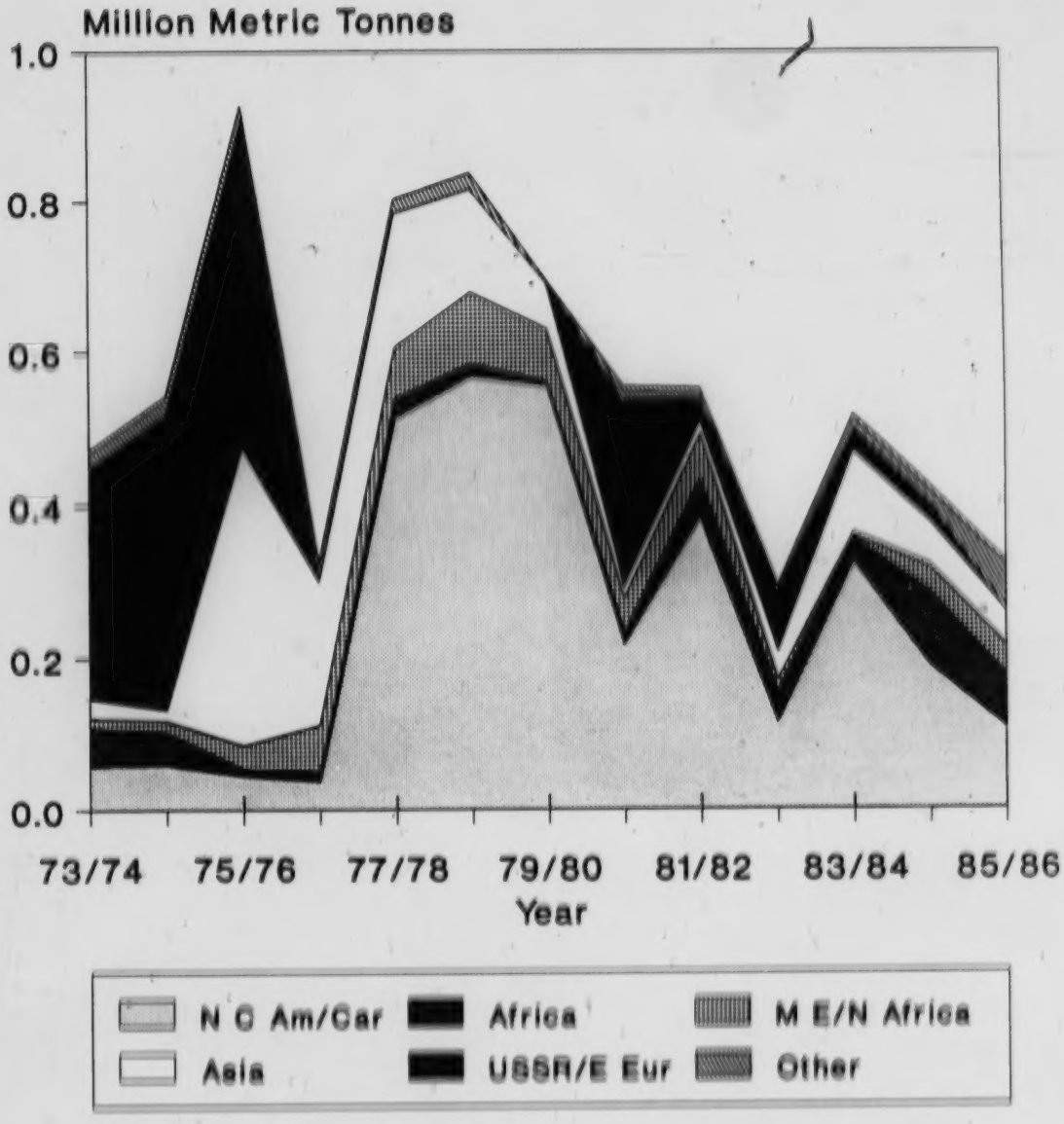
[12]Graphs 6 through 10 are not directly comparable with Graphs 1 through 5 because in the Chapter IV graphs: crop years were used, European Community wheat flour intratrade was excluded, and International Wheat Council data was the basis for the United States Department of Agriculture data matrix.

GRAPH 6
REGIONAL IMPORTS OF FLOUR FROM THE WORLD



Source: U.S.D.A., *Foreign Agriculture Circular - Grains*, 1986.

GRAPH 7
REGIONAL IMPORTS OF FLOUR FROM CANADA



Source: U.S.D.A., *Foreign Agriculture Circular - Grains*, 1986.

Table 8
Regional Imports From the World and Canada and Canadian Market Share
(thousand metric tonnes of flour)

	1973/74 - 1975/76 Average			1982/83 -1984/85 Average				
	Total (1)	Canada (2)	% (3)	Total (4)	Canada (5)	% (6)	(3)x(4) (7)	(5)-(7) (8)
Caribbean & Central America	212.20	52.33	24.66	357.50	209.17	58.51	88.17	121.00
South America	83.13	2.87	3.45	94.27	5.80	6.15	3.25	2.55
East South America	17.60	0.43	2.46	9.00	2.33	25.93	0.22	2.11
West South America	65.53	2.43	3.71	85.23	3.47	4.07	3.16	0.30
Europe	28.93	6.00	20.74	91.03	9.73	10.69	18.88	-9.14
European Community (10)	9.07	3.70	40.81	6.73	5.47	81.19	2.75	2.72
Other Western Europe	19.83	2.30	11.60	15.33	4.27	27.83	1.78	2.49
Eastern Europe	0.03	0.00	0.00	68.97	0.00	0.00	0.00	0.00
Africa and the Middle East	2430.87	54.77	2.25	4254.70	74.30	1.75	95.86	-21.56
North America & the Middle East	2008.80	19.17	0.95	3123.20	17.47	0.56	29.80	-12.33
East Africa	159.67	13.53	8.48	509.10	36.67	7.20	43.15	-6.48
West Africa	243.07	22.07	9.08	538.93	12.83	2.38	48.93	-36.09
Asia	1129.40	143.23	12.68	312.00	68.10	21.83	39.57	28.53
South Asia	759.13	106.57	14.04	174.57	7.40	4.24	24.51	-17.11
South East Asia	85.83	6.70	7.81	65.00	0.50	0.77	5.07	-4.57
East Asia	268.43	29.97	11.16	67.90	60.23	88.71	7.58	52.65
Oceania	101.33	0.00	0.00	53.87	0.00	0.00	0.00	0.00
U.S.S.R.	371.83	371.83	100.00	225.27	41.97	18.63	225.27	-183.30
Others Unspecified	125.83	15.43	12.26	70.03	0.67	0.95	8.59	-7.92
Totals	4483.53	646.47	14.42	5458.67	409.73	7.51	479.58	-69.84

Notes: a. The data in this table do not directly match the data in Table 3 because the totals in this table include imports by minor nations.
b. Sub-regional totals may not equal the regional totals due to the inclusion of minor importers in the regional totals.

If Canadian flour exports had grown at the same rate as world exports, Canada would have exported about 787,070 metric tonnes in 1982/83 - 1984/85. Since actual exports in 1973/74 - 1975/76 were 646,470 metric tonnes, the growth in the world market had an overall positive effect on Canadian exports. However, Canada lost market share in the growing African and Middle Eastern markets and also did not take advantage of growth in the East European market. This loss was somewhat offset by an increased market share in the growing Caribbean and Central American market. Most Canadian market share increases occurred in slow or negative growth markets such as the South American, Western European, and East Asian markets. The loss of the Soviet market also contributed to provide Canada with negative distribution and competitive effects. Consequently, the influence of the size of market effect, distribution effect and competitive effect on Canadian market share can be quantified as 27 per cent, 59 per cent and 13 per cent respectively (Table 9).

The calculations for the United States, on the other hand, indicate that the United States had a positive effect from the increase in the size of the market and from increasing its market share in particular markets. Distribution effects for the United States were minimal. Consequently, it can be inferred that the United States has concentrated its flour marketing efforts on growing markets such as Africa and the Middle East and Eastern Europe. The United States also managed to increase market share in the shrinking Asian market. United States' market share declined in the Oceanian and Western European markets, as it did in the growing western hemisphere markets in South Central America and the Caribbean. Overall, the size of market, distribution and competitive effects can be quantified as 26 per cent, zero per cent and 74 per cent respectively. (Graph 8, Tables 10 and 11).

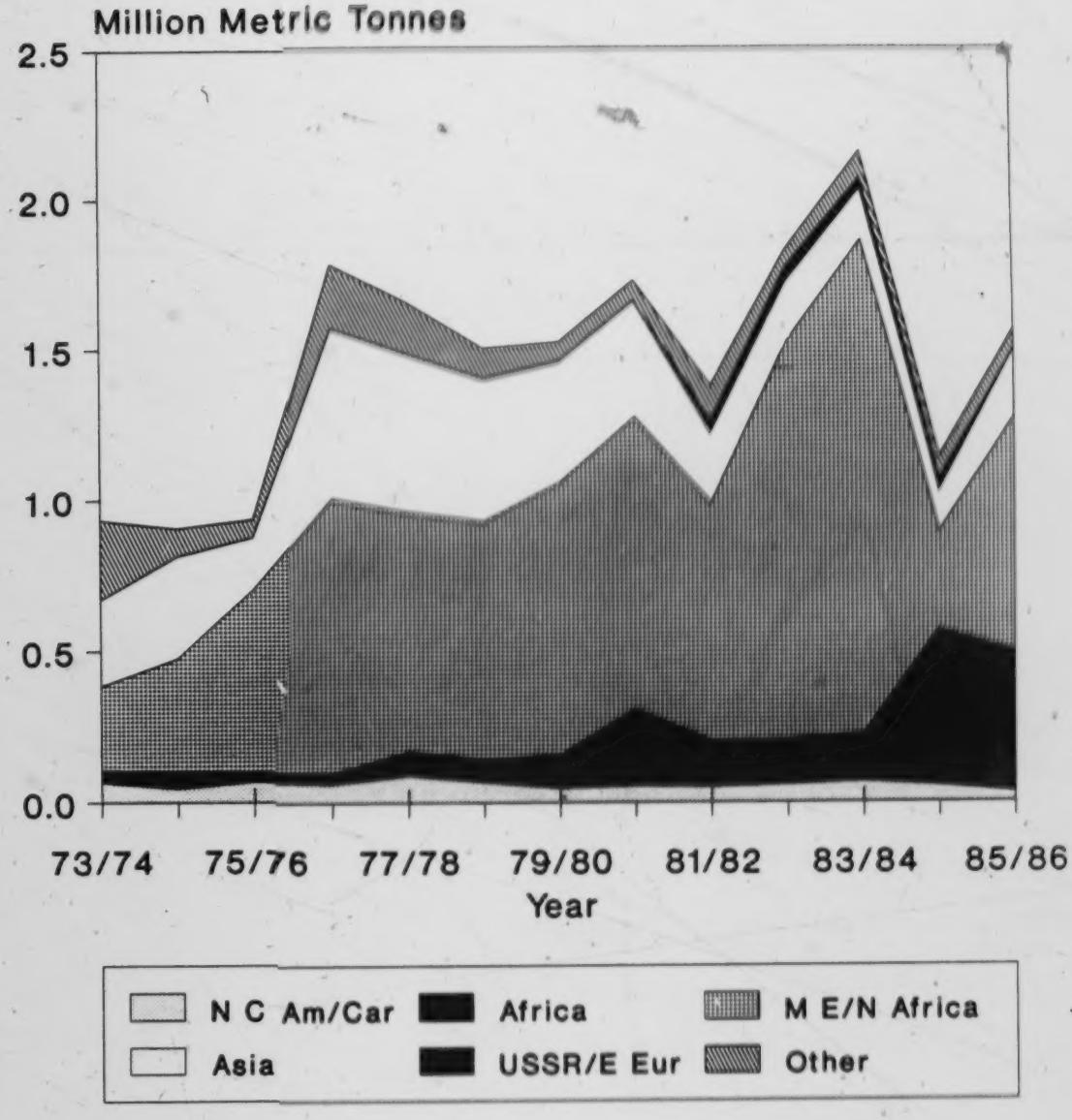
The European Community maintained a stable overall market share at about 59 per cent. However, further analysis shows that had the Community maintained its market share in the growing African, Middle Eastern, Caribbean and Central American markets, it would have fared even better. The European Community's market share also declined in Asia. The Community almost quadrupled its market share in South America and experienced increases in the Soviet Union, Western Europe and Oceania markets. The decline in the Eastern European

Table 9

Market Share Calculations for Canada

	1973/74-1975/76 Average		1982/83-1984/85 Average	
Actual Exports:				
World: thousand tonnes	4483.53		5458.67	
Canada: thousand tonnes	646.47	(A_1)	409.73	(A_2)
Canadian Market Share	14.42	%	7.51	per cent
Canadian Potential Exports:				
1982/83-1984/85				
- if the Canadian 1973/74 average market share was applied to the actual average world exports in 1982/83-1984/85			787.07	(B)
- if Canada maintained the same market share in 1982/83-1984/85 as in 1973/74-1975/76 in designated markets (ie. with standardization for changes in market distribution)			479.58	(C)
	'000 tonnes		%	
Loss for Canada				
- Total loss (A_2-A_1)	-236.73		100.00	
- Size of market effect (B-A_1)	140.60		27.15	
- Distribution effect (C-B)	-307.49		59.37	
- Competitive effect (A_2-C)	-69.84		13.49	

GRAPH 8
REGIONAL IMPORTS OF FLOUR FROM THE UNITED STATES



Source: U.S.D.A., *Foreign Agriculture Circular - Grains*, 1986.

Table 10

Regional Imports From the World and the United States and American Market Share

(thousand metric tonnes of flour)

	1973/74-1975/76 Average			1982/83-1984/85 Average				
	Total	U.S.	%	Total	U.S.	%	(5)x(4)	(5)-(7)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Caribbean & Central America	212.20	59.97	28.26	357.50	60.57	16.94	101.03	-40.46
South America	83.13	69.77	83.92	94.27	49.77	52.79	79.11	-29.34
East South America	17.60	13.83	78.60	9.00	1.20	13.33	7.07	-5.87
West South America	65.53	55.93	85.35	85.23	48.53	56.94	72.75	-24.21
Europe	28.93	10.27	35.48	91.03	46.07	50.60	32.20	13.76
European Community (10)	9.07	3.90	43.01	6.73	1.23	18.32	2.90	-1.66
Other Western Europe	19.83	6.37	32.10	15.33	0.73	4.78	4.92	-4.19
Eastern Europe	0.03	0.00	0.00	68.97	44.13	63.99	0.00	44.13
Africa and the Middle East	2430.87	461.57	18.99	4254.70	1355.70	31.86	807.87	547.83
North Africa & the Middle East	2008.80	418.50	20.83	3123.20	1080.80	34.61	650.67	430.13
East Africa	159.67	15.23	9.54	509.10	239.73	47.09	48.57	191.16
West Africa	243.07	27.83	11.45	538.93	26.90	4.99	61.71	-34.81
Asia	1129.40	265.20	23.48	312.00	169.63	54.37	73.26	96.37
South Asia	759.13	192.27	25.33	174.57	143.10	81.97	44.21	98.89
South East Asia	85.83	51.83	60.39	65.00	25.47	39.18	39.25	-13.79
East Asia	268.43	21.10	7.86	67.90	1.00	1.47	5.34	-4.34
Oceania	101.33	21.67	21.38	53.87	5.67	10.52	11.52	-5.85
U.S.S.R.	371.83	0.00	0.00	225.27	0.00	0.00	0.00	0.00
Others Unspecified	125.83	37.93	30.15	70.03	13.47	19.23	21.11	-7.65
Totals	4483.53	926.37	20.66	5458.67	1700.87	31.16	1126.20	574.66

Notes: a. The data in this table do not directly match the data in Table 3 because the totals in this table include imports by minor nations.

b. Sub-regional totals may not equal the regional totals due to the inclusion of minor importers in the regional totals.

Table 11

Market Share Calculations for the United States

	1973/74-1975/76 Average		1982/83-1984/85 Average	
Actual Exports:				
World: thousand tonnes	4483.53		5458.67	
U.S.: thousand tonnes	926.37	(A_1)	1700.87	(A_2)
American Market Share	20.66	%	31.16	%
U.S. Potential Exports:				
1982/83-1984/85				
- if the American 1973/74-1975/76 average market share was applied to the actual average world exports in 1982/83-1984/85			1127.84	(B)
- if the U.S. maintained the same market share in 1982/83-1984/85 as in 1973/74-1975/76 in designated markets (ie. with standardization for changes in market distribution)			1126.20	(C)
	'000 tonnes		%	
Loss for the U.S.				
- Total loss (A_2-A_1)	774.50		100.00	
- Size of market effect (B-a_1)	201.48		25.90	
- Distribution effect (C-B)	-1.64		0.21	
- Competitive effect (A_2-C)	574.66		73.88	

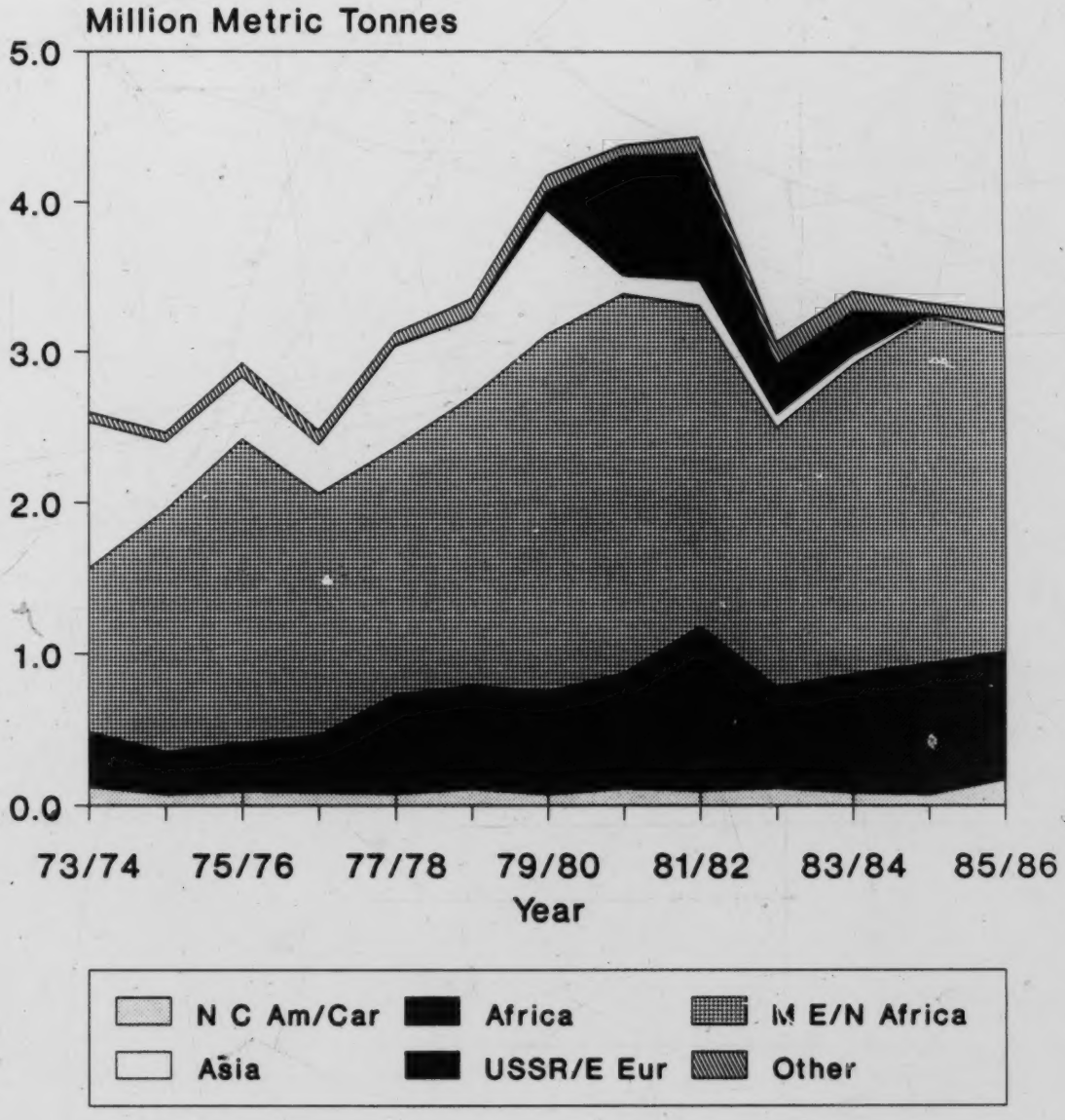
market was irrelevant given that the base period sales were virtually nil. Consequently the European Community experienced positive size of market and distribution effects, but experienced a negative competitive effect. These effects can be quantified as 39 per cent, 31 per cent and 30 per cent respectively (Graph 9, Tables 12 and 13).

Australia experienced a significant loss in market share from about five per cent to less than two per cent of the world market. The increased size of market was insufficient to offset both negative distribution and competitive effects. Australia lost market share in virtually every continent. However, it was able to pick up a larger share of the declining Oceania market (Graph 10, Tables 14 and 15).

Overall then, the increase in the size of market over the study period positively affected all exporters to differing degrees. However, Australia was virtually shut out of the market because of a concentration in lower growth markets and an absolute loss of market share. The results for Canada were virtually the same. However, overall Canadian market share was only halved. The Community maintained its overall market share but only through an increase in market share in some lower growth or stagnant markets. In the Caribbean and Central American market, the European Community gave ground to Canada and in the African and Middle Eastern markets, the Community lost market share to the United States. The Americans generally increased market share at the expense of the Europeans, although some Canadian and Australian markets were influenced.

In comparing these results for the wheat flour market with both the Veeman and Veeman and Schissel studies for the wheat trade, some differences are apparent. The European Community was the biggest beneficiary from size of market effects in this model, while the Americans were most affected in the Veeman and Veeman model for the earlier time period and least affected in the longer time frame. The significance of the size of market effects on the Community in the flour trade model may be largely due to the predominant position of the Community in the world flour market and in part because of the time frame under consideration. Unlike the Schissel model in which all countries benefited from improved competitiveness, in this model only the United States was positively influenced. This

GRAPH 9
REGIONAL IMPORTS OF FLOUR FROM THE EUROPEAN COMMUNITY



Source: U.S.D.A., *Foreign Agriculture Circular - Grains*, 1986.

Table 12

Regional Imports From the World and the European Community and the Community's Market Share

(thousand metric tonnes of flour)

	1973/74 - 1975/76 Average			1982/83 -1984/85 Average				
	Total (1)	E.C. (2)	% (3)	Total (4)	E.C. (5)	% (6)	(3)x(4) (7)	(5)-(7) (8)
Caribbean & Central America	212.20	93.87	44.23	357.50	87.73	24.54	158.14	-70.41
South America	83.13	10.50	12.63	94.27	38.73	41.09	11.91	26.83
East South America	17.60	3.33	18.94	9.00	5.47	60.74	1.70	3.76
West South America	66.53	7.17	10.94	85.23	33.27	39.03	9.32	23.95
Europe	28.93	12.43	42.97	91.03	35.17	38.63	39.12	-3.95
Other Western Europe	19.83	11.17	56.30	15.33	10.33	67.39	8.63	1.70
Eastern Europe	0.03	0.03	100.00	68.97	24.83	36.01	68.97	-44.13
Africa & the Middle East	2430.87	1885.17	77.55	4254.70	2794.17	65.67	3299.57	-505.40
North Africa & the Middle East	2008.80	1566.17	77.97	3123.20	2021.90	64.74	2435.01	-413.11
East Africa	159.67	129.13	80.88	509.10	223.57	43.91	411.74	-188.18
West Africa	243.07	170.53	70.16	538.93	480.87	89.23	378.11	102.76
Asia	1129.40	609.43	53.96	312.00	55.27	17.71	168.36	-113.09
South Asia	759.13	363.33	47.86	174.57	18.30	10.48	83.55	-65.25
South East Asia	85.83	14.13	16.47	65.00	31.63	48.67	10.70	20.93
East Asia	268.43	215.97	80.45	67.90	0.87	1.28	54.63	-53.76
Oceania	101.33	26.73	26.38	53.87	17.67	32 80	14.21	3.46
U.S.S.R.	371.83	0.00	0.00	255.27	183.30	81.37	0.00	183.30
Others Unspecified	125.83	25.80	20.50	70.03	53.80	76.82	14.36	39.44
Totals	4483.53	2663.93	59.42	5458.67	3265.83	59.83	3705.66	-439.83

Notes: a. The data in this table do not directly match the data in Table 3 because the totals in this table include imports by minor nations.

b. Sub-regional totals may not equal the regional totals due to the inclusion of minor importers in the regional totals.

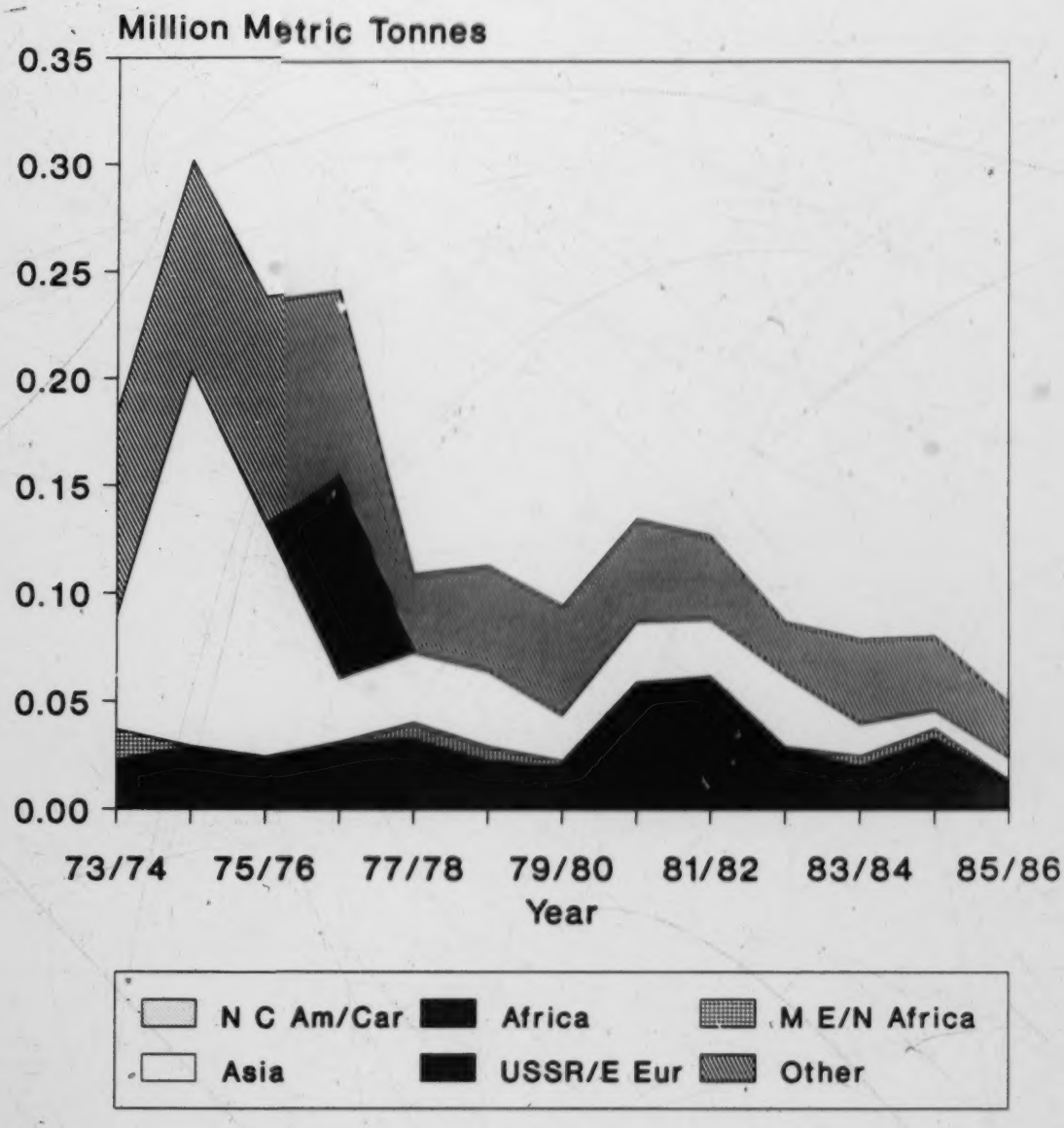
c. Intra European Community is excluded.

Table 13

Market Share Calculations for the European Community

	1973/74-1975/76 Average		1982/83-1984/85 Average	
Actual Exports:				
World: thousand tonnes	4483.53		5458.67	
E.C.: thousand tonnes	2663.93	(A_1)	3265.83	(A_2)
Community Market Share	59.42	%	59.83	%
E.C. Potential Exports:				
1982/83-1984/85				
- if the Community 1973/74-1975/76 average market share was applied to the actual average world exports in 1982/83-1984/85			3243.32	(B)
- if the E.C. maintained the same market share in 1982/83-1984/85 as in 1973/74-1975/76 in designated markets (ie. with standardization for changes in market distribution)			3705.66	(C)
	'000 tonnes		%	
Loss for the Community				
- Total loss (A_2-A_1)	601.90		100.00	
- Size of market effect (B-A_1)	579.38		39.11	
- Distribution effect (C-B)	462.35		31.21	
- Competitive effect (A_2-C)	-439.83		26.69	

GRAPH 10
REGIONAL IMPORTS OF FLOUR FROM AUSTRALIA



Source: U.S.D.A., *Foreign Agriculture Circular - Grains*, 1986.

Table 14

Regional Imports From the World and Australia and Australian Market Share
(thousand metric tonnes of flour)

	1973/74-1975/76 Average			1982/83-1984/85 Average				
	Total (1)	Australia (2)	% (3)	Total (4)	Australia (5)	% (6)	(3)x(4) (7)	(5)-(7) (8)
Caribbean & Central America	212.20	0.70	0.33	357.50	0.00	0.00	1.18	-1.18
South America	83.13	0.00	0.00	94.27	0.00	0.00	0.00	0.00
East South America	17.60	0.00	0.00	9.00	0.00	0.00	0.00	0.00
West South America	65.53	0.00	0.00	85.23	0.00	0.00	0.00	0.00
Europe	28.93	0.23	0.81	91.03	0.03	0.04	0.73	-0.70
European Community (10)	9.07	0.23	2.57	6.73	0.03	0.50	0.17	-0.14
Other Western Europe	19.83	0.00	0.00	15.33	0.00	0.00	0.00	0.00
Eastern Europe	0.03	0.00	0.00	68.97	0.00	0.00	0.00	0.00
Africa and the Middle East	2430.87	29.37	1.21	4254.70	30.53	0.72	51.40	-20.87
North Africa & the Middle East	2008.80	4.97	0.25	3123.20	3.10	0.10	7.72	-4.62
East Africa	159.67	1.77	1.11	509.10	9.13	1.79	5.63	3.50
West Africa	243.07	22.63	9.31	538.93	18.30	3.40	50.18	-31.88
Asia	1129.40	111.53	9.88	312.00	19.00	6.09	30.81	-11.81
South Asia	759.13	96.97	12.77	174.57	5.77	3.30	22.30	-16.53
South East Asia	85.83	13.17	15.34	65.00	7.40	11.38	9.97	-2.57
East Asia	268.43	1.40	0.52	67.90	5.83	8.59	0.35	5.48
Oceania	101.33	52.93	52.24	53.87	30.53	56.68	28.14	2.40
U.S.S.R.	371.83	0.00	0.00	225.27	0.00	0.00	0.00	0.00
Others Unspecified	125.83	46.67	37.09	79.03	2.10	3.00	25.97	-23.87
Totals	4483.53	241.43	5.38	5458.67	82.20	1.51	138.24	-56.04

Notes: a. The data in this table do not directly match the data in Table 3 because the totals in this table include imports by minor nations.

b. Sub-regional totals may not equal the regional totals due to the inclusion of minor importers in the regional totals.

Table 15

Market Share Calculations for Australia

	1973/74-1975/76 Average		1982/83-1984/85 Average	
Actual Exports:				
World: thousand tonnes	4483.53		5458.67	
Australia: thousand tonnes	241.43	(A_1)	82.20	(A_2)
Australian Market Share	5.38	%	1.51	%
Australian Potential Exports:				
1982/83-1984/85				
- if the Australian 1973/74-1975/76 average market share was applied to the actual average world exports in 1982/83-1984/85			293.94	(B)
- if the Australian maintained the same market share in 1982/83-1984/85 as in 1973/74-1975/76 in designated markets (ie. with standardization for changes in market distribution)			138.24	(C)
	'000 tonnes		%	
Loss for Australia				
- Total loss (A_2-A_1)	-159.23		100.00	
- Size of market effect (B-A_1)	52.51		19.87	
- Distribution effect (C-B)	-155.71		58.92	
- Competitive effect (A_2-C)	-56.04		21.21	

difference could be because the increase in the world wheat flour market was modest compared to the increase in the world wheat market. As well, since competitive effects are likely to be due to price effects, favourable American prices and exchange rates may have had an effect. For Canada, negative competitive effects may illustrate the heterogeneity of the products and the fact that the Canadian product would usually be higher priced. The large positive impact of distribution effects on the Community is consistent with Schissel's model, and may reflect the large impact from the size of market effect. Canada was most significantly negatively influenced by the distribution effect. The conclusion of the Veeman and Veeman model that Canadian emphasis in the wheat market during the 1970s was on slow growth markets and as such Canada suffered negative distribution effects during the 1970 to 1974 time period compared to the 1975 to 1979 time frame, is probably applicable to the wheat flour model since Canada has been relatively passive in promoting wheat flour exports. Canada has relied extensively on the Cuban contract which until West Germany entered the bidding, almost went to Canada by default.

V. Conclusions

It is concluded that the world wheat flour market has undergone massive structural change over the past 40 years. The development of international organizations, domestic and international institutions, and economic ties have facilitated trade in general. At the same time, improved wheat production capability in traditional and non-traditional growing regions has created an increased capacity to trade and to some extent has shifted the patterns of trade. In particular, developing countries have been able to produce some of wheat which is increasingly being demanded in the developing world as incomes rise. This increase in incomes in the developing world has led to an increased demand for animal products in the local diets and has created a derived demand for the by-products of the wheat milling process for animal feed. Overall, decreased demand for baked goods in the developed world and relatively stable population growth has increased the reliance of grain exporters on the developing country markets. The food uses of wheat are more varied in developing countries; the traditional western high rising loaf of bread is less common. Developing countries also have less of an ability to pay for the generally higher priced hard wheats and wheat flours. As a result some replacement of hard wheats and hard wheat flours by soft wheats and soft wheat flours has occurred in the market.

Developments in breadmaking technology in the western world have meant that lower protein wheats can now be used to produce leavened white bread, increasing the substitution of lower protein soft wheats for higher protein hard wheats.

Changes in transportation technology, such as the development of bulk handling systems, have lowered the cost of transporting wheat versus flour and appear to have changed some of the locational economics related to flour mills. While mills were formerly located close to the wheat producing regions, newer plants, such as those in Cuba and Sri Lanka, have been located closer to markets.

Government intervention into wheat and flour markets has affected trade and trade patterns. High domestic subsidies in developed countries have produced wheat surpluses. Governments have intervened to dispose of these surpluses through the use of export subsidies

and other export promotions. The European Community appears to have been more aggressive than either the United States or Canada in directing subsidies to flour exports in an attempt to gain benefits from value added processing. The European Common Agriculture Policy has had a direct effect on the market because it has artificially reduced the cost of producing soft wheats, thus widening the price gap between hard and soft wheats. It may have encouraged the propagation of some of the newer baking technologies. It would also have resulted in an advantage in selling to certain markets. Other developed countries have also supported their wheat industries but not to the same extent as the Europeans. The producer subsidy equivalent, an imperfect measure of government support in each region,[13] shows that during the period 1979 to 1988 the Community provided an average of 37.3 per cent support to its wheat industry, the United States 32.2 per cent, Canada 30.5 per cent and Australia 10.9 per cent[14] (O.E.C.D., 1989). While a producer subsidy equivalent has not been calculated for the period prior to 1979, the same pattern of relative support levels might be expected for the 1970s.

Developing countries have also attempted to capture any benefits from value added processing, by building their own milling facilities and in some instances by restricting wheat or wheat flour imports (directly, or indirectly through such means as foreign currency

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[13]The producer subsidy equivalent is an attempt to equate different means of government support, such as direct payments, and border measures (eg. tariffs) which raise prices. It is calculated as the difference between a domestic and world reference multiplied by the level of domestic sales, plus any direct government expenditures. The "percentage" producer subsidy equivalent attempts to show the percent of a producer's income which is attributable to government intervention. Technical problems with the producer subsidy equivalent such as determining accurate reference prices, effects of exchange rate fluctuations and policy inclusions/exclusions limit the interpretations which can be drawn from the measure. Nevertheless it is the most all encompassing measure of support currently available.

[14]Note that for the period under consideration the Special Canadian Grains Program (1986 to 1988) significantly increased Canadian support levels. However, the 1988 drought decreased European Community support levels (due to the rise in world prices). The drought also raised Canadian payments relative to United States payments, since most United States payments are on a per unit basis and there was a significantly smaller crop in 1988, while many Canadian programs such as the Western Grain Stabilization Act make payments based on other criteria. As well, figures for the European Community do not include national subsidies. Thus, the average producer subsidy equivalent for the time period tends to overstate the level of Canadian intervention in the market relative to the United States and the European Community throughout the 1980s.

controls). Some developing countries have maintained low domestic farm prices and encouraged food imports, which in turn has discouraged domestic wheat production.

The simple linear transportation model presented in Chapter III, shows that the patterns of wheat flour trade are influenced by more than locational factors. If wheat flour was traded only according to the economic factor of transportation costs, actual patterns of trade would be expected to approach the optimal solution. This result is not the case. While the model is limited by the assumptions used in its formulation (particularly the assumptions of a homogeneous product, and for much of the model, transportation rates which are solely a function of distance), constraining the model leads it to more closely approximate the current situation. Three of the restrictions (i.e., model restrictions on exports to China, Cuba and the Soviet Union) relate to political intervention in the market either on the part of the seller, as is the case with United States sales to Cuba, or on the part of the purchaser, which appears to occur with respect to the lack of purchases by the Soviet Union and China from the United States. The other restriction relates to the lack of a homogeneous product (this restriction is simulated by model restrictions on Canadian shipments to the Middle East). The formulation of the model does not totally describe the real world since there are other political, economic and product factors which are excluded.

Further analysis through the market share approach in Chapter IV, identified some of the changes in trading patterns in flour from the early 1970s to the early 1980s and attributed these changes to size of market, distribution or competitive effects. Canada was adversely affected by reduced market share in some markets (competitive effects) as well as maintenance of market share in declining markets. An overall increase in the size of the flour market only partially offset these effects. This result indicates that, although there have been structural changes in the world flour market, Canada's passive or misdirected marketing efforts also may have been important factors. The return to a "level playing field" in terms of international competitive subsidization might have some effect on Canada's market share, but unless Canada actively takes part in unsubsidized competition, these effects would be small. With active market participation Canada might either have an excellent market opportunity in

the North African and Middle East Market depending on how restrictive white kernel wheat preferences are in that region; or further opportunities in the Soviet Union and Cuba. Of course, if the United States were to enter the Soviet or Cuban markets extensively, Canadian exports would be expected to decline significantly (Tables 4 and 7).

While the analysis in this thesis is historic in nature and few predictive prescriptions can be drawn, it is interesting to speculate on the potential influence of a positive General Agreement on Tariffs and Trade (G.A.T.T.) outcome in the Uruguay Round negotiations. There are three major players in the agriculture negotiations: the United States, the European Community, and the Cairns Group[15] of thirteen agricultural exporting nations which includes Canada. The United States has advanced the most extreme position calling for:

a. The elimination of export subsidies over a five year period.

b. The elimination of all market access barriers over 10 years through the process of tariffication,[16] followed by staged reductions.

c. Substantial reductions in overall agricultural support through the elimination of highly trade distorting subsidies over 10 years, and discipline on partially trade distorting policies which would be phased out over an agreed time frame, perhaps using a producer subsidy equivalent type of approach. A list of permitted policies would be developed.

d. Improved rules for agriculture to be agreed upon.

e. The development of a safeguard mechanism for the transition period.

f. Agreement on the use of international standards to prevent the use of sanitary and phytosanitary measures to distort trade and the harmonization of, or recognition of the equivalency of national standards.

g. Special and differential treatment for less developed countries.

h. The development of a food aid convention (*Submission of the United States on*

[15]The Cairns Group is made up of Canada, Australia, New Zealand, Argentina, Brazil, Chile, Thailand, Colombia, Hungary, Malaysia, Uruguay, Indonesia and the Philippines.

[16]Tariffication is the term coined for the process of converting non-tariff barriers to tariffs.

Comprehensive Long-Term Agricultural Reform, submitted to the General Agreement on Tariffs and Trade Secretariat October 1989).

The European Community's position, on the other hand, suggests:

a. The use of a support measurement unit (a modified producer subsidy equivalent) to reduce support levels, by an agreed to amount over five years.

b. The use of tariffication would be acceptable in return for rebalancing.[17]

c. Modifications to the variable levy portion of the Common Agriculture Policy to give it a fixed and variable component.

d. Maintenance of national standards for health and sanitary measures in particular circumstances, although overall there would be increased reliance on international standards.

e. Specific and differential treatment for developing countries, including specific measures in favour of least developed net food importing countries (*European Community Agricultural Comprehensive Proposal for the Long Term in the Punta del Este G.A.T.T. Round*, submitted to the General Agreement on Tariffs and Trade Secretariat December 1989).

The Cairns Group has taken the middle ground calling for:

a. Increased market access through a prohibition on the introduction or continued use of all measures not provided for in the General Agreement on Tariffs and Trade.

b. Tariffication of current non-tariff border measures with the tariffs progressively being reduced and expansion in the tariff quotas commensurate with tariff reductions.

c. Reduction in internal support and export subsidies over an agreed time frame, using a producer subsidy equivalent as a yardstick, but with particular policies and programs subject to negotiations. Once again programs would be divided into prohibited, permitted but disciplined, and permitted categories.

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[17]Rebalancing is the proposition that support for some highly protected or subsidized commodities would be lowered, but support would be increased on some commodities which currently have low levels of support.

d. Subjection of sanitary and phytosanitary measures to international rules and the harmonization or recognition of equivalency of national standards.

e. Special and differential treatment for less developed countries including recognition of the special needs of the net food importing, less developed countries.

f. The development of a safeguard mechanism for the transitional period (*The Cairns Group Plan - A Comprehensive Proposal for Long-Term Reform of Agricultural Trade*, submitted to the General Agreement on Tariffs and Trade Secretariat November 1989).

If the General Agreement on Tariffs and Trade round was to achieve the elimination of export subsidies, it might eliminate the differential treatment for wheat and wheat flour exports by developed nations. With the prohibition on processor subsidies by the Subsidies Code, the elimination of export subsidies would remove the other major means of discriminating between wheat and flour through subsidies. The elimination of export subsidies would essentially mean that wheat and flour would compete on the basis of economic criteria. On the other hand, special and differential treatment for developing countries could mean the continued use of import restrictions and subsidies to encourage processing in the developing nations. In addition, not all countries are signatories to the Subsidies Code and it is unclear how the negotiations will deal with the issue of import replacement subsidies.

If domestic subsidies were decreased, a decrease in surplus production and a commensurate increase in world prices might be expected. However, the effects of these price increases on the volumes demanded and the uncertainty of the details of a food aid convention makes the results of decreased domestic supports on the flour market less clear. In any case it is unlikely, at this time, that the trend towards using lower protein wheats would be reversed simply by a return to competitive market conditions, due in part to consumer acceptance of the newer breads and the costs associated with reinvestment in new baking equipment and facilities.

Progress on increasing market access may result in increased wheat flour shipments to markets such as the Community. However, this occurrence would be very dependent on the

hard wheat milling capacity available in the importing regions, the relative price of wheat versus flour, transportation costs for each product and even the relative cost of using a wheat gluten additive versus importing high protein wheat flour into the Community.

Although much of the historic patterns of wheat trade may be explained by government intervention into the marketplace, a reversal to a less interventionist system will not necessarily result in increased trade in wheat flour due to institutional changes that have occurred.

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Appendix A - Structure of the Canadian Flour Industry

There were 47 flour milling plants in Canada in 1984. Most of them were small, specialty mills. Only 14 (30 per cent) of the Canadian mills had a daily capacity in excess of 5,000 hundredweights of flour. These 14 large plants accounted for approximately 75 per cent of Canadian output (R.I.E., 1984, p. 2 and Appendix B). The most recent United States figure available for the purposes of comparison show that in 1977, 30 per cent of American plants had a daily capacity of over 5,000 hundredweights of flour. These plants accounted for nearly 80 per cent of capacity in the United States (Heid, 1980, p. 58). Apparently, the Canadian industry is structured in a similar manner to the American industry, although the American industry is much larger.

The Canadian flour milling industry is quite concentrated. Five firms had multi-mill facilities in 1984. Over 70 per cent of the industry capacity was controlled by Maple Leaf Mills Limited, Ogilvie Mills Limited, and Robin Hood Multifoods Incorporated. Between them, these firms controlled 14 plants of different size (R.I.E., 1984, p. 2 and Appendix B).

About 71 per cent of total capacity was located in Eastern Canada in 1984. This figure represented an increase from 1974 when about 62 per cent of capacity was in the East. Total Canadian capacity increased by 10 per cent between 1974 and 1984 while during the same period there was a 25 per cent increase in eastern Canadian capacity and a 16 per cent decline in western Canadian capacity (Statistics Canada 22-502, 1985, p. 16-18).

Utilization of milling capacity also increased during the 1970s, although this increase was followed by a slight decline between 1979 and 1983. In 1983 a slight upward trend in utilization began, so that by 1985 utilization stood at about 72 per cent of capacity. This level of utilization compared well with many European countries which had lower utilization levels than Canada. Regional volume statistics show a similar pattern to the national average, although utilization in eastern Canadian mills has consistently been higher than in the West. However, rationalization in western mills has narrowed these differences (Statistics Canada 22-502, 1985, p. 18-22; R.I.E., 1984, p. 8).

Much of the physical plant of the Canadian milling industry is old and has no book value. However, there has been moderate investment by many firms to modernize existing

plants, "improve employee safety and reduce dust emissions" (R.I.E. 1984, p. 10).

The flour industry employs approximately 2,939 workers, according to Statistics Canada.[11] The employment of all workers (including those not involved in manufacturing) generated salaries and wages of about $85,862,000 in 1984. The value added by the industry was $202,441,000, of which $154,619,000 was from manufacturing. The prepared flour mixes and cereal foods industry employed an additional 2,919 workers and created a value added of $286,616,000 (Statistics Canada, 32-228).

About 13 per cent of Canadian wheat production is processed domestically. Two-thirds of the flour produced is consumed in Canada (Veeman and Veeman, 1984, p. 70-71). During the 1970s, buoyant export markets and increased consumption of about 10 per cent, resulted in a modest increase in milling activity. This increase occurred despite the loss of the British market, which was probably due to a combination of Britain's entry into the European Community and the widespread adoption of the Chorleywood Bread Process. The amount of wheat milled in Canada peaked in 1979/80 at about 2.6 million tonnes. However, since then flour production has contracted due to two factors. First, since 1978 per capita consumption of flour in Canada has declined by about 10 per cent. Second, a major export market, Cuba, has purchased less flour from Canada since that country expanded its domestic milling facilities. In 1985 the amount of wheat milled in Canada was approximately 2.4 million tonnes. Annual per capita consumption of cereal products in Canada since 1980 has ranged between 55.73 and 60.95 kilograms. About 78 per cent of this consumption is in bread products, 16 per cent is in cake and pastry products and six per cent is in pasta products. The consumption of bread flour works out to about 100 loaves of bread (675 grams or 24 ounces) for each person per year (R.I.E., 1984, p. 5-6; Statistics Canada, 22-201; 32-229; 22-502, 1985, p. 22).

About 81 per cent of the wheat milled in Canada is hard wheat; soft wheat accounts for approximately 13 per cent and durum for about five per cent of milling activity. Low protein cake flours are mainly milled in Ontario (about 87 per cent), although with increased

[11]Note that industry estimates for 1984, which are probably more accurate, put employment figures at approximately 4,000 workers (R.I.E., 1984, p. 17).

production of soft white wheat in the West, some of the milling of soft wheat flour has shifted to the West. Almost 70 per cent of the flour produced in Canada is spring patent flour, the "white flour used for breads and in retail flour" (R.I.E., 1984, p. 6). The widespread use of hard wheat flour in flour sold at the retail level and in breadmaking flour is peculiar to Canada, and in contrast to countries like the United States, Canadian millers tend to rely on spring rather than winter wheats for these flours. Whole wheat and non-wheat flours (such as rye, corn oats and triticale), although only a small percentage of the total grain milled, are increasing in importance with the increased consumer demand for whole grain and specialty breads (R.I.E., 1984, p. 6; Statistics Canada, 22-502, 1985, p. 13-16).

The consumers of flour can be divided into "Family flour users, bakeries, biscuit manufacturers, miscellaneous food processors and industrial users" (R I.E., 1984, p. 5). The largest percentage of flour is used by bakeries, followed by miscellaneous food processors. Biscuit manufacturers also account for a large porportion of usage, but they use mainly soft wheat flours.[19] Retail sales of flour are relatively small, but the sector is important as it indicates trends in consumption. Industrial users include animal feed processors, adhesive manufacturers, and foundries.

About 350,000 tonnes of flour are exported annually. In recent years this amount has been less than one per cent of the value of total agricultural exports, a reduction from the late 1970s when flour sales were over two per cent of the value of agricultural exports. However the value of bakery products exported has increased over the same time period. The two major export markets for flour are Cuba (about 60 per cent of Canadian exports) and federal government food aid purchases (about 40 per cent of Canadian exports) (R.I.E., 1984, p. 7; Agriculture Canada, 1988, p. 85-86, 1984, p. 89-90; Statistics Canada, 22-502, 1985, p. 24).

The Cuban contract was shared by all members of the Canadian National Millers' Association according to their share of capacity. The three largest milling firms negotiated the terms of the contract. Since exports of flour provide a significant market for millers, the construction of another Cuban mill of similar capacity to existing mills in Cuba would

[19]The proportions are approximately 60 per cent soft wheat flour, 20 per cent hard wheat flour and 20 per cent flours other than wheat (R.I.E., 1984, p. 5).

seriously deplete export demand. Fortunately, further expansion of the Cuban milling industry is not expected until the late 1990s (R.I.E., 1984, p. 7-9).

Constraints on increased food aid purchases by the federal government include budgetary limitations, international competitiveness in food aid, the construction of milling facilities in many third world countries and competitiveness by other food processors for aid dollars. Only modest increases are expected in the future for flour sales to the federal government (R.I.E., 1984, p. 7-9).

Appendix B - Wheat Processing Technology

A. Technical Aspects of Flour

Flour is a heterogeneous product. The baking quality of a particular wheat depends on the purpose for which it is to be used and on a number of environmental and genetic factors. Different types of wheat produce different flours which are suitable for different products.

There are three broad categories of wheat. Hard wheats are grown in drier climates found in such areas as western Canada, the north western United States, Australia, and parts of Russia. Hard winter and hard spring wheats have a higher protein content than soft wheats, however, they are also lower yielding. Hard wheats sell at a premium price because they produce a flour which is superior for baking high rising loaves of bread. Soft wheats are grown in higher moisture grain producing regions of the world, including irrigated areas in southern Alberta. They produce a flour which is superior for baking cakes and cookies. Durum, a different species of wheat, produces semolina flour, which is used for making pasta products.

In addition to the contribution the type of wheat makes to baking quality, different varieties of wheat may have characteristics which make them suitable or unsuitable for particular products. For example, Maris Huntsman, a high yielding British variety cannot be used in bread flour. It has high alpha amylase levels which give the bread a sticky crumb which cannot be sliced (Lupton and Pushman, 1975, p. 86-87).

Bread making quality is a function of both protein quantity and quality. Genetic factors affect both. Environmental factors such as soil fertility; the amount, frequency and timing of rainfall; temperature and the prevalence of diseases such as rust, also affect the quality of the flour, mainly by their affect on protein levels (Bushuk, 1982, p. 550). There are a variety of tests available to evaluate wheat. For example, at terminal elevators, the Near Infrared Reflectance (N.I.R.) test is used to determine the levels of different proteins (Bushuk, 1982, p. 541).

Wheat is evaluated on the basis of a number of properties. A specific property of a wheat is dependent upon the additive effect of that property with other components and the manner in which the property is modified in the presence of other components (Bushuk,

1982, p. 543). Most important of all is its viscoelasticity, which makes the flour in the bread rise but still hold together. Viscoelasticity is determined by gluten[20] content and quality. The level of wheat starch and wheat fat in the flour is also important. Other starches and fats added in baking will not substitute for that found in wheat. Wheat is evaluated on colour. The hardness or vitreousness of the grain is important since harder kernels provide good separation of the bran and endosperm during milling and yield a purer flour (i.e., no large amounts of free starch particles). The blending capacity of a wheat, particularly with soft wheats is important, especially for export. The yield of patent flour[21] is important to millers. The ash content of a flour gives a guide to the overall extraction rate possible. A wheat must also be tolerant to variations in processing, either from different milling systems or variations in baking techniques. The alpha amylase level of a wheat determines how it will react with yeast. If alpha amylase levels are too low they can be increased by the addition of malting barley flour or some other additive. But if the levels are too high they cannot be reduced (Bushuk, 1982, p. 543-546; Irvine, 1975, p. 117-121).

The quality factors for wheat translate into a set of characteristics that bakers desire. They want a flour which will absorb a large quantity of water, which in turn reduces input costs. The time required for mixing the dough is flour specific. The bakers want a consistent time which is not too long. The dough must retain its desirable attributes over a long fermentation process and have a good capacity to retain carbon dioxide. The dough must also retain its desired shape and size (Bushuk, 1982, p. 546-547).

B. The Milling Process

The objective of milling grain is to make cereals easier to prepare into palatable products. In milling the bran and the germ are removed. Since these products are "rich in protein, B vitamins, minerals and fat", (Hoseney, 1986, p. 133) milling reduces the

[20]Gluten is a component of wheat protein.
[21]"Patent flour is the portion of a straight run of flour which is brighter in colour and with a lower ash content than the balance of the flour" (C.I.G.I., 1982, p. 960).

nutritional value of grain while increasing its ability to be prepared into products acceptable to consumers.

Prior to milling the grain is cleaned. Pieces of metal, straw, other grains and other impurities are removed. In a modern mill the grain passes through a magnetic seperator, vibrating screens, an aspirator and finally into a disc seperator. The beard is broken off and the kernel buffed in a scouring process. Finally the grain is washed to remove any dirt and small stones. The next step is to bring the water content of the wheat up to about 16 per cent moisture. This "strengthens the bran, allows better separation, and makes the endosperm more friable" (Inglett and Anderson, 1974, p. 190). This process is called conditioning or tempering (Hoseney, 1986, p. 133-139).

Hard wheat is usually milled in a roller mill, although some plants use a combination of roller and impact mills. The grain passes through a corrugated roller system called "break" rolls. They crack the kernel, and the flour sifted and separated out at this point is called "break flour". The by-product of this stage is almost pure bran. The flour still in the system is called middling flour. Middling flour is sent through smooth rollers a number of times. The middlings are sifted and purified[22] so the wheat germ and smaller particles of bran flake out. These small particles are called shorts and they are used for "special foods and animal feed" (Sultan, 1981, p. 19).

The total amount of flour produced, including all break and middling flour, is called straight grade or 100 per cent extraction flour. It amounts to about 72 per cent of the weight of wheat used. Patent flour is produced in the first few reduction rolls (first few streams of middling flour). Patent flour varies from between 25 and 40 per cent to between 65 and 90 per cent of extraction depending on the end use. The former is called short patent while the latter is called long patent. There are also several grades of "clear flour" which remain when the patent flour is removed. Clear flour contains more protein than patent flour, but it is lower quality protein (Hoseney, 1986, p. 143-145; Inglett and Anderson, 1974, p. 193-195; Sultan, 1981, p. 18-20).

[22]The purifier is an inclined sieve which air passes over to remove bran particles and seperate the flour according to coarseness (Hoseney, 1986, p. 140).

In Canada there are four basic grades of flour produced: retail flour (top patent), commercial bakers' flour (long patent), flour for use in rye bread (first clear flour), and low grade flour for industrial use (second clear flour) (Brennan, 1982, p. 578-581).

Flour may be treated after milling. Commonly, vitamins are added. Maturing agents, bleaching agents,[23] and self rising agents may also be added. The flour may be dried to extend shelf life. It may be reground and separated into protein and starch so that some bread wheat can be used for cakes and some soft wheat can be used for bread.[24] The flour may be wetted and agglomerated to improve its "wettability and dispersibility in liquids" (Inglett and Anderson, 1974, p. 195-196).

Soft wheat milling is slightly different than hard wheat milling. Soft wheats require a shorter tempering time. Since the endosperm contains more starch, the kernel reduces to flour more quickly. It takes approximately 20 per cent less power to mill soft wheat than hard wheat. The starch in the soft wheat must not be damaged by over-grinding or the baking quality will be affected. Purification is not an important part of soft milling systems, probably because the finer starch particles tend to aggregate, which results in poorer sifting properties (Hoseney, 1986, p. 141-143; Harwood, 1982, p. 641-642; Inglett and Anderson, 1974, p. 196-197).

Durum milling is similiar to hard wheat milling except that a shorter tempering time is required. The product, semolina, is the middlings from the durum (Inglett and Anderson, 1974, p. 197).

C. Baking Technology

There are three basic processes in making bread: mixing, fermentation and baking. Newer systems try to shorten the time involved in the first two steps. This time saving can be done by pre-fermenting in a liquid tank, or chemically or mechanically aiding dough

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[23]If flour is stored for a period of time, the bleaching and maturing happens naturally.

[24]Note that pastry flour is not the same as cake flour. Cake flour has lower protein than bread flour, but still requires a sufficient quantity of gluten to hold the mixture together (Sultan, 1981, pp. 22-23).

development (Cotton and Ponte, 1974, p. 206-240; Hoseney, 1986, p. 208-241).

Traditional breadmaking systems are of two basic types. In the straight dough system, the fermentation takes place in the loaf. The dough is allowed to rise one or more times during fermentation. The gas is punched out of it each time until the final proof stage when the loaf is allowed to rise before baking. The sponge and dough system differs in that the yeast and a portion of the flour (the sponge) are allowed to ferment seperately. Then the remainder of the ingredients are mixed with the sponge, and a much shorter intermediate proof is required (Hoseney, 1986, p. 208-211).

A major break-through in modern baking systems came in 1926 when Swanson and Working published a paper entitled "Mechanical Modification of Dough to Make it Possible to Bake Bread With Only the Fermentation in the Pan". Nearly 25 years later Dr. J.C. Baker developed a process for continuous bread production without bulk fermentation. This process was patented in 1950. There have been a series of modifications since, including the development of the Chorleywood Bread Process. All of these processes require high levels of oxidizing improvers such as potassium iodate, potassium bromate or ascorbic acid. Some countries prohibit the use of these additives, but in many countries these newer breadmaking processes are being adopted. Europe and Australia use continuous breadmaking processes. In North America, continuous processes were adopted, but then in many cases were abandoned or modified due to the lack of consumer acceptability of the product, which is somewhat different, mainly in texture, than bread produced by traditional methods. It must be noted that even the traditional systems used in North America have become greatly mechanized (Hoseney, 1986, p. 211; Irvine, 1975, p. 121-122).

The new technology has had a significant impact on the demand for hard wheat flours, therefore it may be worthwhile to look at the advantages of such a process. To illustrate, the Chorleywood Process is used. Other continuous processes have similar benefits. The Chorleywood process eliminates bulk fermentation, an innovation which has a number of advantages for the baker. The Chorleywood process has benefits such as a 60 per cent time saving which increases the output of a single plant. It requires 75 per cent less space than does

a conventional bakery. There is a 75 per cent reduction in the quantity of dough being handled at any point in the process. Required manpower is reduced by one or two operators (from about seven). "Clean-up time is reduced by half and maintenance and lubrication costs are largely eliminated" (Pyler, 1982, p. 683). There is a four per cent increase in yield which translates into a cash saving on raw materials. The bread takes longer to stale and flour of one to one and one half per cent lower protein can be used. This lower protein requirement means that many of the soft wheats or a blend of soft and hard wheats can be used in the flour. (A decrease of 1.5 per cent in protein requirements can make many of the lower protein European wheats such as Mildress suitable for bread production.) Since soft wheats are cheaper, the cost of inputs is reduced dramatically (Chamberlain, 1975, p. 264-267; Tipples, 1982, p. 626-630).

The process also requires high energy input for the high powered batch or continuous mixer, the presence of the previously mentioned oxidising improvers, high levels of yeast and the inclusion of 0.7 per cent of the flour weight in fat. However the benefits of the process appear to outweigh the costs in some markets (Chamberlain, 1975, p. 264-267; Tipples, 1982, p. 626-630).

Appendix C - Resource Costs, Shadow Prices and Sensitivity Analysis For the Transportation Modc!

An assessment of the effect on relative prices due to the choice of the optimum route can be derived from an equilibrium cost matrix (Appendix Table 1). The figures in the column and row entitled market price differentials (X) and producer price differentials (Y) represent the marginal value products or dual costs of Model 3. The producer price differentials show the costs of the constraints. If for example, Canada could ship one more unit of flour, the cost of the optimal shipping pattern would be reduced. Note that in this case a new optimum solution could be found. Therefore, the model, given its assumptions, indicates Canada and Australia could be shipping more flour than they presently do and perhaps should be expanding production capacity. In practice, non-economic considerations influence what actually happens in the market. Another way of looking at the producer price differential is that Canadian flour can sell for more per tonne more than American or European Community flour (on average) before consumers in Canadian flour importing markets will begin to change suppliers.[25] On the other hand, the market price differentials show the cost of providing one more unit of product, should the importer demand it. The other elements in the matrix are the equilibrium prices, or the price of transportation on the various routes which would make consumers indifferent to the source of their supplies (i.e., the actual shipping cost minus the shadow price from the optimum solution).

The costs associated with using non-optimum routes are given in Appendix Table 2. These are the shadow prices or the reduced costs values from the MPS/360 printout. They represent the additional cost of putting another unit along a particular route. From this table it can be seen that the additional costs associated with shipping flour from Canada to China, the United States to the Middle East / North Africa or India, and Australia to India, are not high. This low cost may explain why there is considerable trade on the first three of these routes. Only a small change in transportation rates makes these optimal routes.

Information may be derived from looking at the effects on the optimum solution of changes in the values of the freight rates between various points. The most likely changes in a

[25]It would be expected that Canadian hard wheat flours would sell at a premuim due to the higher associated production costs. Consequently, this model may explain why Canadian flour is able to remain competitive.

Appendix Table 1
Model 3 Equilibrium Transport Cost Matrix 1982/83 - 1984/85
(American dollars per tonne of flour)

	IMPORTING REGIONS												
Exporting Regions	Europe	North Africa & Middle East	West Africa	South Asia	South East Asia	East Asia	U.S.S.R.	Caribbean & Central America	East Africa	East South America	West South America	Dummy Destination	Producer Price Differentials (Y)
Ports	Rotterdam	Egypt	Cameroon	India	Philippines	China	Black Sea	Cuba	Tanzania	Brazil	Peru		
Canada	7.65	•	12.82	23.97	13.86	18.63	13.81	9.16	20.98	12.82	8.38	35.91	-4.09
U.S.A.	11.74	18.83	16.91	28.06	17.95	•	•	•	25.07	16.91	12.47	40.00	
E.C.	N/A	18.83	16.91	28.06	17.95	22.72	17.90	13.25	25.07	16.91	12.47	40.00	
Australia	6.67	13.76	11.84	22.99	12.88	17.65	12.83	8.18	20.00	11.84	7.40	34.93	-5.07
Market Price Differentials (x)	11.74	18.83	16.91	28.06	17.95	22.72	17.90	13.25	25.07	16.91	12.47	40.00	

Notes:
N/A - not applicable
• - Shipment restricted
Source:
MPS/360 Computer Printout, Section 1 - Rows and Section 2 - Columns.

Appendix Table 2
Model 3 Cost of Using Non-Optimum Routes 1982/83 - 1984/85
(American dollars per tonne of flour)

	IMPORTING REGIONS											
Exporting Regions	Europe	North Africa & Middle East	West Africa	South Asia	South East Asia	East Asia	U.S.S.R.	Carribbean & Central America	East Africa	East South America	West South America	Dummy Destination
Ports	Rotterdam	Egypt	Cameroon	India	Philippines	China	Black Sea	Cuba	Tanzania	Brazil	Peru	
Canada	2.13	•	3.17	7.80	7.03	0.60			6.10	2.74	6.75	4.09
U.S.A.		1.15		1.36		•	•	•	11.79			
E.C.	N/A		2.45		15.02	10.98		6.35		3.18	10.05	
Australia	19.18	8.91	10.71	0.05	3.92		13.82	17.94		11.45	13.34	5.07

Notes:
N/A - not applicable
• - Shipment restricted
Source:
MPS/360 Computer Printout, Section 1 - Rows and Section 2 - Columns.

group of freight rates would be within a shipping conference. This rate change in turn might lead to rate changes in a competing conference. However, without information on the competitive factors which might influence changes in rates, it is difficult to judge what changes are likely to be realistic. Interesting information may still be derived by changing the overall freight rates of each supplier and analyzing the effects on the model. Canadian freight rates were increased by multiples of 10 per cent up to 50 per cent. The optimal solution did not change until rates were increased by almost 30 per cent. At this point Canada began losing market share in the Soviet market to the European Community and when rates were increased to 40 per cent, Canada lost the entire Soviet market. At a 40 per cent level of change the United States began shipping flour to the Middle East / North Africa to fill the chasm left by the European Community shift to supply the Soviet market (Appendix Tables 3 and 4).

The results of the model were much more sensitive to changes in American freight rates. At an approximate 15 per cent increase in rates, the United States began losing market share to the European Community in the West African market (Appendix Table 5). However only a five per cent decrease in costs began shifting the optimal allocation (Appendix Table 6). The United States gained market share at the expense of the European Community in North Africa / Middle East, and South Asia. With a 40 per cent decrease in costs, Canada takes over the European market from the United States (Appendix Table 7). Some of Canada's shipments to the Soviet Union are replaced by shipments from the European Community. The United States takes more of the Middle East / North African market from the European Community.

When European Community transportation rates are increased by only two per cent, the optimal solution begins to change. At the 10 per cent level the European Community loses the South Asia market and loses market share in the Middle East / North African, and East Africa (Appendix Table 8). The European Community gains market share in the Soviet Union at the expense of Canada, but Canada begins shipping to China. Australian production is diverted to East Africa, at the expense of the European Community.

Appendix Table 3
Model 3 Optimal Shipping Pattern When Canadian Transport Costs are Increased by 30% 1982/83 - 1984/85
(thousand tonnes of flour)

	IMPORTING REGIONS											
Exporting Regions	Europe	North Africa & Middle East	West Africa	South Asia	South East Asia	East Asia	U.S.S.R.	Caribbean & Central America	East Africa	East South America	West South America	Dummy Destination	Total Exports (tonnes)
Ports	Rotterdam	Egypt	Cameroon	India	Philippines	China	Black Sea	Cuba	Tanzania	Brazil	Peru		
Canada		•					82.20	358.53				50.91	491.64
U.S.A.	55.83		538.00		68.77	•	•	•		9.03	85.27	1284.14	2041.04
E.C.	N/A	3123.26		174.57			143.07		478.10				3919.00
Australia						67.29			28.27				95.56
Total Imports (tonnes)	55.83	3123.26	538.00	174.57	68.77	67.29	225.27	358.53	506.37	9.03	85.27	1335.05	6547.24

Notes:
N/A - not applicable
• - shipment restricted
Source:
MPS/360 Computer Printout, Section 1 - Rows and Section 2 - Columns.

Appendix Table 4
Model 3 Optimal Shipping Pattern When Canadian Transport Costs are Increased by 40%, 50% 1982/83 - 1984/85
(thousand tonnes of flour)

	IMPORTING REGIONS												
Exporting Regions	Europe	North Africa & Middle East	West Africa	South Asia	South East Asia	East Asia	U.S.S.R.	Caribbean & Central America	East Africa	East South America	West South America	Dummy Destination	Total Exports
Ports	Rotterdam	Egypt	Cameroon	India	Philippines	China	Black Sea	Cuba	Tanzania	Brazil	Peru		
Canada		*						358.53				133.11	491.64
U.S.A.	55.83	82.20	538.00		68.77	*	*	*		9.03	85.27	1201.94	2041.04
E.C.	N/A	3041.06		174.57			225.27		478.10				3919.00
Australia						67.29			28.27				95.56
Total Imports (tonnes)	55.83	3123.26	538.00	174.57	68.77	67.29	225.27	358.53	506.37	9.03	85.27	1335.05	6547.24

Notes:
N/A - not applicable
* - Shipment restricted
Source:
MPS/360 Computer Printout, Section 1 - Rows and Section 2 - Columns.

Appendix Table 5
Model 3 Optimal Shipping Pattern When United States Transport Costs are Increased by 20%, 30%, 40%, 50% 1982/83 - 1984/85
(thousand tonnes of flour)

	IMPORTING REGIONS												
Exporting Regions	Europe	North Africa & Middle East	West Africa	South Asia	South East Asia	East Asia	U.S.S.R.	Caribbean & Central America	East Africa	East South America	West South America	Dummy Destination	Total Exports (tonnes)
Ports	Rotterdam	Egypt	Cameroon	India	Philippines	China	Black Sea	Cuba	Tanzania	Brazil	Peru		
Canada		•					133.11	358.53					491.64
U.S.A.	55.83		487.09		68.77	•	•	•		9.03	85.27	1335.05	2041.04
E.C.	N/A	3123.26	50.91	174.57			92.16		478.10				3919.00
Australia						67.29			28.27				95.56
Total Imports (tonnes)	55.83	3123.26	538.00	174.57	68.77	67.29	225.27	358.53	506.37	9.03	85.27	1335.05	6547.24

Notes:
N/A - not applicable
• - Shipment restricted
Source:
MPS/360 Computer Printout, Section 1 - Rows and Section 2 - Columns.

Appendix Table 6
Model 3 Optimal Shipping Pattern When United States Transport Costs are Decreased by 10%, 20%, 30% 1982/83 - 1984/85
(thousand tonnes of flour)

	IMPORTING REGIONS												
Exporting Regions	Europe	North Africa & Middle East	West Africa	South Asia	South East Asia	East Asia	U.S.S.R.	Caribbean & Central America	East Africa	East South America	West South America	Dummy Destination	Total Exports (tonnes)
Ports	Rotterdam	Egypt	Cameroon	India	Philippines	China	Black Sea	Cuba	Tanzania	Brazil	Peru		
Canada		•					133.11	358.53					491.64
U.S.A.	55.83	1109.57	538.00	174.57	68.77	•	•	•		9.03	85.27		2041.04
E.C.	N/A	2013.69					92.16		478.10			1335.05	3919.00
Australia						67.29			28.27				95.56
Total Imports (tonnes)	55.83	3123.26	538.00	174.57	68.77	67.29	225.27	358.53	506.37	9.03	85.27	1335.05	6547.24

Notes:
N/A - not applicable
• - Shipment restricted
Source:
MPS/360 Computer Printout, Section 1 - Rows and Section 2 - Columns.

Appendix Table 7

Model 3 Optimal Shipping Pattern When United States Transport Costs are Decreased by 40%, 50% 1982/83 - 1984/85
(thousand tonnes of flour)

	IMPORTING REGIONS												
Exporting Regions	Europe	North Africa & Middle East	West Africa	South Asia	South East Asia	East Asia	U.S.S.R.	Caribbean & Central America	East Africa	East South America	West South America	Dummy Destination	Total Exports (tonnes)
Ports	Rotterdam	Egypt	Cameroon	India	Philippines	China	Black Sea	Cuba	Tanzania	Brazil	Peru		
Canada	55.83	*					77.28	358.53					491.64
U.S.A.		1165.40	538.00	174.57	68.77	*	*	*		9.03	85.27		2041.04
E.C.	N/A	1957.86					147.99		478.10			1335.05	3919.00
Australia						67.29			28.27				95.56
Total Imports (tonnes)	55.83	3123.26	538.00	174.57	68.77	67.29	225.27	358.53	506.37	9.03	85.27	1335.05	6547.24

Notes:
N/A - not applicable
* - shipment restricted
Source:
MPS/360 Computer Printout, Section 1 - Rows and Section 2 - Columns.

Appendix Table 8
Model 3 Optimal Shipping Pattern When European Community Transport Costs are Increased by 10%, 20%, 30%, 40%, 50% 1982/83 - 1984/85
(thousand tonnes of flour)

	IMPORTING REGIONS												
Exporting Regions	Europe	North Africa & Middle East	West Africa	South Asia	South East Asia	East Asia	U.S.S.R.	Caribbean & Central America	East Africa	East South America	West South America	Dummy Destination	Total Exports (tonnes)
Ports	Rotterdam	Egypt	Cameroon	India	Philippines	China	Black Sea	Cuba	Tanzania	Brazil	Peru		
Canada		•				67.29	65.82	358.53					491.64
U.S.A.	55.83	1109.57	538.00	174.57	68.77	•	•	•		9.03	85.27		2041.04
E.C.	N/A	2013.69					159.45		410.81			1335.05	3919.00
Australia									95.56				95.56
Total Imports (tonnes)	55.83	3123.26	538.00	174.57	68.77	67.29	225.27	358.53	506.37	9.03	85.27	1335.05	6547.24

Notes:
N/A - not applicable
• - Shipment restricted
Source:
MPS/360 Computer Printout, Section 1 - Rows and Section 2 - Columns.

A cost decrease on European Community routes begins to affect the market at the 12 per cent level. The United States benefits in terms of total volume shipped. Canada is affected by a shift in shipments to Europe instead of the Soviet Union (Appendix Table 9). At greater than 20 per cent cost decreases, however, Canadian markets are not affected (Appendix Table 10). Instead, Australia begins shipping to South East Asia, formerly an American market, and loses the East African market. Australian shipping prices must increase by 25 per cent to begin influencing the optimal trade pattern. At between 30 and 50 per cent increases in rates, Australia loses the East African market to the European Community (Appendix Table 11). Rate decreases on Australian routes simply shift Australian trade, first away from East Africa and then away from China and into South Asia (Appendix Tables 12 and 13). Canada gains the Chinese market as Australian flour is diverted to South Asia.

In summary, total shipments by Australia are very insensitive to changes in the rates of the suppliers. Increases in Australian rates must be quite high to decrease Australian shipments, but relatively small decreases in Australian rates quickly shift Australian markets. Canadian shipments are also influenced relatively little by changes in various rates, although the Soviet market is the most sensitive. Under certain scenarios the Chinese and European markets become open to Canada. The United States and the European Community routes are the most sensitive to change. Not only do small increases in each others' rates cause a corresponding loss in total volume shipped, the rate changes cause considerable shifts in the patterns of trade.[26]

[26]Since transportation costs are only one aspect of the total cost of a product, this may also explain why the Americans and Europeans are so committed to an agricultural subsidy war — their natural markets tend to overlap.

Appendix Table 9
Model 3 Optimal Shipping Pattern When European Community Transport Costs are Decreased by 20% 1982/83 - 1984/85
(thousand tonnes of flour)

	IMPORTING REGIONS												
Exporting Regions	Europe	North Africa & Middle East	West Africa	South Asia	South East Asia	East Asia	U.S.S.R.	Caribbean & Central America	East Africa	East South America	West South America	Dummy Destination	Total Exports (tonnes)
Ports	Rotterdam	Egypt	Cameroon	India	Philippines	China	Black Sea	Cuba	Tanzania	Brazil	Peru		
Canada	50.91	•					82.20	358.53					491.64
U.S.A.	4.92		538.00		68.77	•	•	•		9.03	85.27	1335.05	2041.04
E.C.	N/A	3123.26		174.57			143.07		478.10				3919.00
Australia						67.29			28.27				95.56
Total Imports (tonnes)	55.83	3123.26	538.00	174.57	68.77	67.29	225.27	358.53	506.37	9.03	85.27	1335.05	6547.24

Notes:
N/A - not applicable
• - Shipment restricted
Source:
MPS/360 Computer Printout, Section 1 - Rows and Section 2 - Columns.

Appendix Table 10

Model 3 Optimal Shipping Pattern When European Community Transport Costs are Decreased by 30%, 40%, 50% 1982/83 - 1984/85
(thousand tonnes of flour)

	IMPORTING REGIONS												
Exporting Regions	Europe	North Africa & Middle East	West Africa	South Asia	South East Asia	East Asia	U.S.S.R.	Caribbean & Central America	East Africa	East South America	West South America	Dummy Destination	Total Exports (tonnes)
Ports	Rotterdam	Egypt	Cameroon	India	Philippines	China	Black Sea	Cuba	Tanzania	Brazil	Peru		
Canada		•					133.11	358.53					491.64
U.S.A.	55.83		515.36		40.50	•	•	•		9.03	85.27	1335.05	2041.04
E.C.	N/A	3123.26	22.64	174.57			92.16		506.37				3919.00
Australia					28.27	67.29							95.56
Total Imports (tonnes)	55.83	3123.26	538.00	174.57	68.77	67.29	225.27	358.53	506.37	9.03	85.27	1335.05	6547.24

Notes:
N/A - not applicable
• - Shipment restricted
Source:
MPS/360 Computer Printout, Section 1 - Rows and Section 2 - Columns.

Appendix Table 11
Model 3 Optimal Shipping Pattern When Australian Transport Costs are Increased by 30%, 40%, 50% 1982/83 - 1984/85
(thousand tonnes of flour)

	IMPORTING REGIONS												
Exporting Regions	Europe	North Africa & Middle East	West Africa	South Asia	South East Asia	East Asia	U.S.S.R.	Caribbean & Central America	East Africa	East South America	West South America	Dummy Destination	Total Exports (tonnes)
Ports	Rotterdam	Egypt	Cameroon	India	Philippines	China	Black Sea	Cuba	Tanzania	Brazil	Peru		
Canada		*					133.11	358.53					491.64
U.S.A.	55.83		538.00		68.77	*	*	*		9.03	85.27	1284.14	2041.04
E.C.	N/A	3123.26		174.57			92.16		506.37			22.64	3919.00
Australia						67.29						28.27	95.56
Total Imports (tonnes)	55.83	3123.26	538.00	174.57	68.77	67.29	225.27	358.53	506.37	9.03	85.27	1335.05	6547.24

Notes:
N/A - not applicable
* - Shipment restricted
Source:
MPS/360 Computer Printout, Section 1 - Rows and Section 2 - Columns.

Appendix Table 12
Model 3 Optimal Shipping Pattern When Australian Transport Costs are Decreased by 10% 1982/83 - 1984/85
(thousand tonnes of flour)

	IMPORTING REGIONS												
Exporting Regions	Europe	North Africa & Middle East	West Africa	South Asia	South East Asia	East Asia	U.S.S.R.	Caribbean & Central America	East Africa	East South America	West South America	Dummy Destination	Total Exports tonnes)
Ports	Rotterdam	Egypt	Cameroon	India	Philippines	China	Black Sea	Cuba	Tanzania	Brazil	Peru		
Canada		•					133.11	358.53					491.64
U.S.A.	55.83		538.00		68.77	•	•	•		9.03	85.27	1284.14	2041.04
E.C.	N/A	3123.26		146.30			92.16		506.37			50.91	3919.00
Australia				28.27		67.29							95.56
Total Imports (tonnes)	55.83	3123.26	538.00	174.57	68.77	67.29	225.27	358.53	506.37	9.03	85.27	1335.05	6547.24

Notes:
N/A - not applicable
• - Shipment restricted
Source:
MPS/360 Computer Printout, Section 1 - Rows and Section 2 - Columns.

Appendix Table 13
Model 3 Optimal Shipping Pattern When Australian Transport Costs are Decreased by 20%, 30%, 40%, 50% 1982/83 - 1984/85
(thousand tonnes of flour)

	IMPORTING REGIONS												
Exporting Regions	Europe	North Africa & Middle East	West Africa	South Asia	South East Asia	East Asia	U.S.S.R.	Caribbean & Central America	East Africa	East South America	West South America	Dummy Destination	Total Exports (tonnes)
Ports	Rotterdam	Egypt	Cameroon	India	Philippines	China	Black Sea	Cuba	Tanzania	Brazil	Peru		
Canada		•				67.29	65.82	358.53					491.64
U.S.A.	55.83		538.00		68.77	•	•	•		9.03	85.27	1284.14	2041.04
E.C.	N/A	3123.26		79.01			159.45		506.37			50.91	3919.00
Australia				95.56								•	95.56
Total Imports (tonnes)	55.83	3123.26	538.00	174.57	68.77	67.29	225.27	358.53	506.37	9.03	85.27	1335.05	6547.24

Notes:
N/A - not applicable
• - Shipment restricted
Source:
MPS/360 Computer Printout, Section 1 - Rows and Section 2 - Columns.